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ABSTRACT

This teacher's guide is intended to be used with "Genes and Surroundings," an activity unit on human and medical genetics for junior high and middle school students. The unit emphasizes variability and diversity in genetics and is organized around five themes: (1) individuality; (2) continuity; (3) variability in relation to others; (4) variability in time; and (5) adaptation. The initial section of the teacher's guide provides a list of materials needed for each of the 25 activities, an overview of the unit, recommended administrative arrangements including a letter to parents and a parent permission form, organization and goals of the program, teaching considerations, and evaluation suggestions. Each activity has specific instructions which are divided into eight parts: focus; objectives; additional learning opportunities; materials and advance preparation needed; teaching considerations including instructional methods, background information, and alternative approaches; guide to class discussions; suggestions for further exploration; self-check key; and new words. A test item bank to assist in test development and tear sheets for use with some of the activities are included. (DC)

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GENES AND SURROUNDINGS



The Center for Education in
Human and Medical Genetics



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TEACHER'S GUIDE



A Continuing Program of the BSCS

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GENES AND SURROUNDINGS



**The Center for Education in
Human and Medical Genetics**

TEACHER'S GUIDE



A Continuing Program of the BSCS



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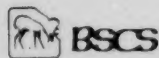
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FOREWORD

Adolescence is a time of rapid growth and change. The transition from child to young adult is felt and expressed in numerous ways by the emerging adolescent. The simultaneous occurrence of physical changes, new, sometimes unsettling emotions, and changing values contributes to the struggle for a sense of identity. Always the underlying question for the adolescent seems to be, "Am I different? Do I fit in?"

Human genetics is the science of human variability--its origins and its implications. Nowhere is that variability more evident than during adolescence, as anyone who has worked with junior high or middle school students knows quite well.

The materials that follow have been designed to examine human genetics from the perspective of variability and diversity. In doing so, the activities often make use of the raw materials available in any junior high or middle school classroom; the students are asked to observe, record, and interpret the variability that surrounds them. They are asked to consider its biological roots and its ultimate expression in the myriad environments that constitute modern society.

In that sense, these experimental materials represent a departure from more traditional approaches to genetics. That approach, however, has not been undertaken lightly. The activities in this program represent almost five years of analysis of human genetics education. Also in recognition of the tremendous diversity among junior high and middle school students, the materials have been designed to accommodate a wide range of cognitive skills and social and emotional development.

The persons you see listed as authors and project staff represent only a fraction of the total number of persons who have contributed to the development of objectives and content for this program. The individuals are too numerous to catalogue here, but their expertise spans the disciplines, from medical genetics and health to educational psychology and classroom teaching, and to theology and bioethics.

We are grateful to the staff of the Health Services Administration for their continued support of this project. Their recognition that public education and effective health care are mutually supportive will contribute significantly to progress in health promotion and disease prevention. We hope you enjoy using these materials in the classroom as much as we enjoyed preparing them.

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MATERIALS REQUIRED

SECTION I YOU AND ME

<u>ACTIVITY</u>	<u>MATERIALS</u>	<u>REQUIRES ADVANCED PREPARATION</u>
1. No Two Alike	Stamp pad Index cards (unlined 5" x 8") Magnifying glass (optional)	Make cards, and collect extra stamp pads or alternatives.
2. Another You	6 paper squares (2cm on each side) Sheet of graph paper Ruler	Make squares and bar graphs.
3. Something of Value	Mystery Clues	Cut out one set of Mystery Clues for each group of students.
4. What Does It Take?	None	Review directions for solving Ann's class schedule. Read Manuel's story. Contact resource people. Collect resource materials.

SECTION II GENERATIONS

5. Generations	24 Jelly beans (6 red, 6 green, 6 yellow, and 6 blue) Paper cups Felt marking pens (black, red, green, yellow, and blue)	Collect materials. Practice using the pedigree.
6. Family Trees and Characteristics	Drawing paper Ruler Circle pattern (nickel) Square pattern (2 cm square)	Cut out 2 cm squares. Try to find out if any prefer not to use their own family pedigree.
7. A Chromosome Is...	None	Refresh memory on chromosomes, karyotypes and cell division. Invite someone from March of Dimes, genetics counseling centers, or other groups to speak to classes.
8. Sex Chromosomes	Inheritance Spinner Transparency Overlays: Sex Chromosomes (A,B,C) Push pins Scissors	Read teaching considerations carefully. Review use of the transparencies. Use the Inheritance Spinner to become familiar with it. Review the concept of independent probability.
9. A Matter of Control	2 strips of construction paper (1 cm x 4 cm) 2 strips of clear plastic (1 cm x 4 cm)	Cut paper and/or plastic strips. Review activity carefully to determine if this should be teacher led or directed in your class.
10. Predicting Inheritance	*Inheritance Spinner with Spinner Cards Push pins (2) Scissors	Review use of Inheritance Spinner and 6 Spinner Cards
11. Genetic Conditions	None	Call or write March of Dimes for Medical History forms. Read case histories and chart (page 38) to anticipate possible problems and questions. Call local agencies to invite speaker(s) on genetic conditions relevant to interests and ethnic backgrounds of the class. Ask the school nurse of any of your students are affected by conditions you cover.
12. From One Generation To Another *Tear sheets	*Creature Card Set Brads (12 per student) Scissors	Advance reading and manipulation of card sets. Optional preparation of a sample creature and its offspring.

ACTIVITY SECTION III VARIETY	MATERIALS	REQUIRES ADVANCED PREPARATION
13. Variety In Living Things	* Living Things Card Set * Chromosomes of Living Things Card Set	Form 10 teams to work with Living Things and Chromosomes of Living Things Card Sets. Cut apart only the Living Things Card Sets. Review different ecosystems with students. Collect pictures of examples and discuss the flora and fauna of each. Read teaching considerations carefully.
14. I Am Me And You Are You	Metric ruler String (25 cm long)	
15. Genes and Surroundings	Genes and Surroundings slide/sound program Slide projector Cassette Tape player	Preview the Genes and Surroundings Sound/Slide Program
16. Decisions, Decisions	None	Read decision problems from student material and summary questions found in Teacher's Guide prior to this activity.
SECTION IV CHANGE		
17. Change In Living Things	Colored pencil Ruler	Read activity to become familiar with timelines. Collect additional timeline data. Review teaching considerations.
18. Growth And Change	None	
19. Growing Up, Growing Older	None	Review use of growth curves.
20. Different Kinds of Growth	Growing pictures Scissors	Review activity and "Growing" comic book.
SECTION V ENVIRONMENT		
21. What Is An Environment?	None	Collect short stories and magazines.
22. What Is Adaptation?	Glue Construction paper Paper clips Scissors Toothpicks Masking tape Pencil Paper Tempera paint (white,black,green) Stapler String Assortment of "odds and ends"	Prepare a demonstration organism which shows special adaptations. Collect items from home for use in Part Two.
23. Time Machine	Role cards Costumes and props	Collection of costumes and props suitable to the following times: Prehistoric Pioneer days Early 1900's Modern times
24. Stomach Aches and Milk	15-30 popbeads Paper clips (or appropriate model) * Transparency overlay on genes	Read background information on <u>Lactose Intolerance</u> .
25. Cancer and Heredity	2 slides (cell division normal, cancer) Slide projector Index cards (3" x 5") Scissors Stapler	Collect items for activity. Preview slides.

*Tear sheets

I. GENES AND SURROUNDINGS -- AN OVERVIEW

The material in Genes and Surroundings is designed to emphasize five organizing themes: Individuality, Continuity, Variability in Relation to Others, Variability in Time, and Adaptation. These themes form the framework for an instructional program in human and medical genetics for emerging adolescents (junior high and middle school students). The instructional materials are designed to match the varying levels of cognitive development and social maturity of students ages 11-14. A topic as broad as human and medical genetics cannot be covered in depth in a short time period nor is an in-depth approach appropriate for students at this age level. However, precursor concepts can be discussed which will help form a basis for ideas that students will consider in the future as they think about personal and social issues. These precursor concepts are reflected in the five organizing themes.

The chart on the next page indicates the degree to which individual activities address these themes.

- XX = Central to the activity
- X = Also present in the activity

ACTIVITY NUMBER	ACTIVITY TITLE	INDIVIDUALITY	CONTINUITY	VARIABILITY IN RELATION TO OTHERS	VARIABILITY IN TIME	ADAPTATION
1	No Two Alike	XX		X		
2	Another You	XX		X		X
3	Something of Value	XX		X		
4	What Does It Take?	XX		X		
5	Generations	X	XX	X	X	
6	Family Trees and Character- istics	X	XX	X	X	
7	A Chromosome Is...	X	XX	X		
8	Sex Chromosomes	X	XX	X	X	
9	A Matter of Control	X	XX	X	X	
10	Predicting Inheritance	X	XX	X	X	
11	Genetic Conditions	X	XX	X		
12	From One Generation to Another	X	XX	X	X	X
13	Variety in Living Things	X	X	XX	X	X
14	I Am Me And You Are You	X	X	XX	X	
15	Genes and Surroundings	X	X	XX	X	
16	Decisions, Decisions	X	X	XX		
17	Change in Living Things	X	X	X	XX	
18	Growth and Change	X	X	X	XX	
19	Growing Up, Growing Older	X	X	X	XX	
20	Different Kinds of Growth	X	X	X	XX	
21	What Is An Environment?	X	X	X		XX
22	What Is Adaptation?	X	X	X	X	XX
23	Time Machine	X	X	X	X	XX
24	Stomach Aches and Milk	X		X	X	XX
25	Cancer And Heredity	X		X	X	XX

II. ADMINISTRATIVE ARRANGEMENTS

To investigate issues relating to genes and surroundings and their effects upon our lives, students must have access to school and community resources. They also may need the opportunity to work independently outside the classroom and outside the school. Certain administrative arrangements should be made. Although this section relates primarily to arrangements in high schools, it can be adapted easily to junior high or middle schools having similar administrative requirements.

If administrators understand the goals and support the rationale of the program, they will support the idea of independent work by students. Explain the philosophy, rationale, and goals thoroughly to your administrators. Then indicate the need for students to be able to work independently outside the school and ask if any special arrangements need to be made for them to work at libraries or conduct interviews.

A sample letter to inform parents about the program is included in this section. This kind of letter can be used to acquaint parents with the program and to obtain approval for participation by their children. In the field testing of similar programs, no parent ever refused to sign such a form. Explaining the goals and the necessity for independent work was sufficient to obtain signatures from those few parents who did call with further questions.

You probably will want to show the letter you plan to send parents to the appropriate administrator for approval. Or, signed letters indicating parental approval may serve to persuade an administrator to provide the necessary support needed for use of these materials.

SAMPLE PARENT PERMISSION LETTER

Dear Parent:

Beginning on (date) and continuing for about _____ weeks, students in (name of class) will be using a curriculum entitled "Genes and Surroundings," developed by the Center for Education in Human and Medical Genetics, an ongoing program of the Biological Sciences Curriculum Study, a nonprofit curriculum development organization.

The program is designed to provide each student with opportunities to investigate basic genetics principles in the context of human genetics. A major goal is to provide each student with opportunities to investigate heredity, environment, and their interactions and assess the effects of each on themselves and society in general. In some instances, the students' investigations will require collecting information and data outside the school on their own and often without teacher supervision. Examples of such activities include conducting surveys, using public libraries, and conferring with individuals or members of organizations in the community.

This letter is being sent to you for two reasons: To inform you about this curriculum and its use in the class where your daughter or son is enrolled, and to ask permission for your daughter or son to participate in the out-of-classroom activities which are suggested in some of the materials.

Please sign the form below to indicate your wishes and ask your daughter or son to return this form to me as soon as possible. If you have any questions concerning the program, please feel free to call me at 000-0000. Thank you for your cooperation.

Sincerely,

Administrator or Teacher

_____ I hereby grant permission for my daughter/son to participate in out-of-class activities.

_____ I do not grant permission for my daughter/son to participate in out-of-class activities.

Student's name

Parent's Signature

Genes and Surroundings

Date

1x

A PARENT'S GUIDE TO GENES AND SURROUNDINGS

Genes and Surroundings provides junior high and middle school students with the opportunity to explore basic genetic principles in the context of human genetics. The material is divided into five areas of emphasis. These are: Individuality, Continuity, Variability in Relation to Others, Variability in Time, and Adaptation. Students are provided opportunities to investigate current information about human genetics and to assess the effect of gene/environment interactions on themselves and society in general. The following themes are presented in the program.

Individuality

1. Awareness that each individual is unique.
2. Recognition that individuality results from the aggregation of many characteristics of human development.
3. Recognition of the personal, cultural and societal implications of individuality.

Continuity

1. Understanding that similarities and differences within and between families are observable evidence of the transmission of characteristics from generation to generation.
2. Recognition that there are different modes of inheritance.
3. Awareness that different modes result in different degrees of predictability.
4. Realization that heritable characteristics contribute significantly to an individual's health status.

Variability in Relation to Others

1. Recognition that some characteristics vary continuously while others vary discontinuously.
2. Awareness that variation is greater between species than within species.
3. Awareness of their own positions on the continuums of human diversity.

Variability in Time

1. Understanding that there is an orderly progression in human growth and development.
2. Recognition that development results in continuous change.
3. Awareness that rate and extent of change varies from individual to individual.
4. Realization that an individual fluctuates between health (equilibrium) and disease (disequilibrium).

Adaptation

1. Awareness that development is influenced by genetics, environment, and experience.
2. Recognition that some environmental and experiential variables are controlled by the individual or society.

x

3. Appreciation that some of an individual's capabilities and limitations are defined by one's genotype.
4. Recognition that the present state of the human species is a result of progressive adaptation.
5. Appreciate that the rate of modification of the environment can exceed the ability of the species to adapt.

Parents were asked to become involved in the program throughout its development. Parents can help implement the program in the classrooms.

Here are several ways you can become a part of the program:

- Interact informally with your student about what he or she is experiencing with the module. Ask about activities--what is going on in and out of class. Ask to see their worksheets, reports and evaluations they complete on activities. Share your own ideas and perceptions with your student. Discuss with her or him questions about the activities.
- Help facilitate out-of-class activities. Several community investigations are suggested in the program. Check with the teacher to see how you might help your student or others in the class expand their learning outside the class.
- Be a resource person yourself. If you work in an area related to any of the modules, offer your talents as a resource person to be interviewed or visited by students. Or, arrange a classroom presentation.

If you would like to be involved with Genes and Surroundings for the middle school, fill out the form below and return it to school.

I would like to be involved with the Genes and Environment for the middle school program by _____

Name of Student _____

Phone Number (s) _____

Your Name _____

III. ORGANIZATION OF GENES AND SURROUNDINGS

Field tests of the Genes and Surroundings program have shown that its activities are most appropriate for average ability students. Enrichment activities are suggested in the Going Further section for advanced students. Other activities may also be used. The success of this program depends in large part to the attention and planning given to accommodate the variety of emotional and cognitive maturity among students at this age. Teachers should examine each set of activities to determine how they should be used with their students. When appropriate, certain activities may be deleted or other activities inserted to accommodate the special needs of their student population.

Most of the Genes and Surroundings activities are designed to be used in one class period. The activities are divided into sections which correspond with the five organizing themes that are addressed in the program. (See Figure A, p. xvi). The teacher is encouraged to sense the attitudes and enthusiasm of the students for some of the Going Further suggestions in the activity. One possible way of using the materials is shown below. (Six to seven weeks will be needed for this schedule.) NOTE: Be sure you read Facilitating Discussions, p. xxi, before using the materials.

- | |
|--|
| DAY 1 - Activity 1, No Two Alike
2 - Activity 2, Another You
3 - Activity 3, Something of Value
4 - Activity 4, What Does It Take?
5 - Summarize ideas in this section about Individuality.
Introduce and review information about cells to determine amount of background information which will be needed in following section. |
| 6 - Activity 5, Generations
7 - Activity 6, Family Trees and Characteristics
8 - Activity 7, A Chromosome Is...
9 - Activity 8, Sex Chromosomes
10 - Activity 9, A Matter of Control
11 - Activity 10, Predicting Inheritance
12 - Activity 11, Genetic Conditions
13 - Activity 12, From One Generation to Another
14 - Summarize the concepts presented in Section II, Generations. More than one day may be needed for this summary and reinforcement of new concepts which were presented. Individual activities may require more than one day if additional background information for the concepts needs to be reviewed. |
| 15 - Activity 13, Variety in Living Things
16 - Activity 14, I Am Me And You Are You
17 - Activity 15, Genes and Surroundings
18 - Activity 16, Decisions, Decisions
19 - Summarize the concepts presented in Section III, Variety. Introduce the relationship of variety in living organisms and change. |
| 20 - Activity 17, Change in Living Things
21 - Activity 18, Growth and Change
22 - Activity 19, Growing Up, Growing Older
23 - Activity 20, Different Kinds of Growth
24 - Activity 21, What Is An Environment?
25 - Summarize Section IV, Change. Introduce the concept of environment and its possible effect on changes in living organisms. |

- 26 - Activity 22, What Is Adaptation?
- 27 - Activity 23, Time Machine
- 28 - Activity 24, Stomach Aches and Milk
- 29 - Activity 25, Cancer and Heredity
- 30-31 - Summarize material presented in GENES AND SURROUNDINGS. Administer student evaluations or encourage class discussions about current issues that students have become aware of by studying these materials.

Figure A shows the Genes and Surroundings module divided into five sections, 1) Individuality, 2) Continuity, 3) Variability in Relation to Others, 4) Variability in Time and 5) Adaptation. Each section contains four to eight activities, with the first activity in each serving as an introduction. Activities increase slightly in difficulty as one progresses toward the end of a section. These different levels are designed to correspond with different grades or maturity found in junior high/middle school populations. The developers realize that a great deal of variability exists among adolescents. Therefore, the Genes and Surroundings materials are intentionally flexible to assist the teacher in providing appropriate academic experiences for his or her students. Between each section the teacher can choose one or two class periods to summarize the concepts which have been presented and introduce the concepts to be studied in the next session.

If scheduling presents a problem, alternative methods can be used for presenting the material. These alternatives are described below.

- Alternative 1 - Teachers may select one of the five sections to present as a unit. For example, if a teacher has only two weeks in which to present these materials, he or she may choose to concentrate on one of the five theme areas, such as Individuality or Adaptation.
- Alternative 2 - Teachers who wish to present a broad view of genetics may choose to present only the introductory activities. These activities will serve to supplement an already defined genetics/biology/science unit or provide a general introduction to genetics.
- Alternative 3 - Teachers may select the introductory activities and any other level of activities. Teachers should remember to consider the students' emotional and cognitive maturity when selecting the activity level.
- Alternative 4 - Teachers may choose to select individual activities. Activities vary in difficulty and teachers who wish to use only selected activities may find it necessary to provide background information.

Many of the activities provide information that may be needed in succeeding ones. If the alternative methods are used in presenting the materials from Genes and Surroundings, it may be necessary for the teacher to provide occasional background information for individual activities.

Using alternative methods successfully with Genes and Surroundings will in large part depend upon the teacher's ability to determine her or his students' emotional and cognitive maturity. The teacher is encouraged to consider each of these factors carefully when deciding which activities to use.

INTRODUCTORY

INCREASING DIFFICULTY

YOU AND ME (Individuality)	NO TWO ALIKE	ANOTHER YOU	SOMETHING OF VALUE	WHAT DOES IT TAKE?	
GENERATIONS (Continuity)	GENERATIONS	FAMILY TREES AND CHARACTERISTICS	A CHROMOSOME IS... SEX CHROMOSOMES A MATTER OF CONTROL	PREDICTING INHERITANCE GENETIC CONDITIONS	FROM ONE GENERATION TO ANOTHER
VARIETY (Variability in relation to others)	VARIETY IN LIVING THINGS	I AM ME AND YOU ARE YOU	GENES AND SURROUNDINGS	DECISIONS, DECISIONS	
CHANGE (Variability in time)	CHANGE IN LIVING THINGS	CHANGE	GROWING UP, GROWING OLDER	DIFFERENT KIND OF GROWTH	
ENVIRONMENT (Adaptation)	WHAT IS AN ENVIRONMENT?	WHAT IS ADAPTATION?	TIME MACHINE	STOMACH ACHES AND MILK	CANCER AND HEREDITY

Figure A.

GENES AND SURROUNDINGS--ACTIVITY DESCRIPTIONS

ACTIVITY	TITLE	TYPE	DESCRIPTION
1	No Two Alike	Individual or Team	An introductory activity that introduces differences among individuals. Students use fingerprints as an example of uniqueness.
2	Another You	Individual	Students examine their awareness that development is influenced by genetics and environment and that some values relating to development are culturally derived.
3	Something of Value	Individual or Team	Students learn that each person has special talents that can be useful to themselves and to others. Students examine their own talents and those of their classmates.
4	What Does It Take	Individual or Team	By listening to a story and compiling lists of talents students learn that different people are good at different things and that talents often go hand in hand with interests.
5	Generations	Individual or Team	Students use a simple model system to show that genes are transmitted from generation to generation.
6	Family Trees and Characteristics	Individual	Students construct pedigree charts to show relationships among family members.
7	A Chromosome Is...	Individual	Students analyze a human karyotype to learn there is an underlying pattern to human growth and development.
8	Sex Chromosomes	Individual or Team	Students use an Inheritance Spinner to discover there are two kinds of chromosomes that determine the sex of a child.
9	A Matter of Control	Individual or Team	Students use opaque and transparent strips to learn characteristics may be inherited in a dominant or recessive pattern.
10	Predicting Inheritance	Individual or Team	Students investigate the combination of genes to produce dominant and recessive characteristics.
11	Genetic Conditions	Team	Students read case histories to learn that many genetic conditions exist and that some of these conditions cause medical problems.

12	From One Generation To Another	Individual or Team	Students create a "creature" to learn that living things may vary across many generations, yet they are similar from one generation to another.
13	Variety In Living Things	Individual or Team	Students examine different types of environments and organisms to learn about variation among living things.
14	I Am Me And You Are You	Individual or Team	Students observe, measure, and record data for five personal characteristics to develop an appreciation of the normal variation in human characteristics.
15	Genes and Surroundings	Individual	Students develop an appreciation of the importance of genotype/environment interactions by viewing a sound/slide program and answering a series of related questions.
16	Decisions, Decisions	Individual or Team	Students investigate the decision-making process and recognize the highly individual nature of most choices.
17	Change In Living Things	Individual	Students use timelines to compare the developmental rates of different organisms.
18	Growth And Change	Individual or Team	Students sequence photographs and identify stages in their own development to develop an understanding of the orderly progression in human growth and development.
19	Growing Up, Growing Older	Individual or Team	Students construct bar graphs to compare the developmental rates of different adolescents.
20	Different Kinds Of Growth	Individual or Team	Students read a Growing Comic Book and examine changes in the growth of a girl's childhood to young adulthood to learn about different kinds of growing.
21	What Is An Environment?	Individual	Students identify different parts of their environment to learn that many different kinds of things make up the environments of human beings.
22	What Is Adaptation?	Individual or Team	Students compare different types of adaptations of living organisms to learn special ways living things fit into their environment.

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23	Time Machine	Team	Students take part in skits to show that people adapt to their environment in different ways.
24	Stomach Aches And Milk	Individual or Team	The principal of adaptation is introduced using a reading on lactose intolerance.
25	Cancer And Heredity	Individual or Team	Students are introduced to some basic concepts concerning the mechanism, danger, and possible causes of cancer in humans.

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IV. GENERAL GOALS OF THE GENES AND SURROUNDINGS PROGRAM

The purpose of the materials in Genes and Surroundings is to provide factual information about human genetics that is absent or inadequate in existing curriculums for emerging adolescents (junior high and middle school students). The content principles are developed within a context of personal and societal relevance to enhance student's application (and reflection upon) that knowledge now and in the future. For example, rather than presenting genetics as an isolated discipline, the materials emphasize the interaction of hereditary material and the environment and the implications of this interaction on lifelong issues, such as health and quality of life. The materials are designed for integration into existing curricular slots--primarily general science, social science, and health. Teaching genetics as if it were an isolated entity having little to do with regular course offerings in the life sciences and social sciences would misrepresent the fundamental, integrative nature of the discipline. Genes and Surroundings is designed to match the developmental levels of students in the 11-14 age group and provides a range of activities consistent with the diversity of cognitive levels and learning styles commonly found in this population. Within this framework, the program will relate basic knowledge in human genetics to the student's social environment and personal growth both now and in the future.

FACILITATING DISCUSSIONS

The Physical Setting

The usual seating arrangement of all desks in rows facing front is unsuitable for either small- or large-group discussions. To establish a physical environment conducive to discussion, put chairs around small tables in a random arrangement, move desks into circles, or move stools around lab tables. If you have nothing but bolted-down desks or auditorium seats in your classroom, find some open space and allow students to sit on the floor. If possible, you may consider conducting class in the cafeteria, gymnasium, conference room, student lounge, outdoors--anywhere the environment will allow face-to-face interaction among students.

Encouraging Student Participation

The following strategies will help create an atmosphere conducive to inquiry and analysis:

- Establish and maintain a positive attitude by demonstrating a high level of personal enthusiasm for and familiarity with the curriculum. Invite student participation and inquiry by encouraging alternative ideas and divergent views.
- Attend to individual differences among students by receiving all responses graciously and without personal bias.

Avoid the following strategies:

- Giving information that students might obtain from available resources or from other members of the discussion group.
- Permitting a few participants to dominate the discussion.
- Rejecting any comment that is presented seriously.
- Responding in a negative way to students who express opinions that disagree with your own.
- Standing at the front of the group as an authority figure.

Dealing with Issues and Values

This curriculum provides an opportunity for each student to discuss, interpret, and evaluate human genetics information within a context of personal and social relevance. Critical to the flow of ideas and quality of exchange is the role and attitude of the instructor as facilitator. What follow are some essential points in facilitating value-oriented discussions.

Neutrality probably is the single most important attribute of a successful discussion facilitator. Within the framework of neutrality, certain behaviors will aid members of the group in learning to balance factual information with feelings:

- Ask members of the group to respond to or build on each other's ideas.
- Ask questions that will help your students distinguish between those components of an idea or issue that can be answered through scientific research and those components that are a matter of personal or cultural values.
- Through unbiased questioning, help participants examine critically all views presented.
- Keep discussion relevant and moving forward by questioning or posing an appropriate problem or hypothetical situation.
- Respect all sincere contributions equally, regardless of whether you agree or disagree.
- Encourage individuals to contribute, but do not force reluctant students into the discussion.
- Respect silence between contributions. Reflective discussions are often slow. If you break the silence, students may let you dominate the discussion.
- Avoid seeking consensus on all issues. The issues raised are multifaceted, and divergent points of view are desirable. In some cases, however, consensus on a compromise solution to a problem may be demonstrated as a powerful determinant of cooperative community action.
- Avoid praising the substance of contributions, especially points of view with which you agree. But do praise willingness to contribute and evidence of careful thought by making such comments as "Thanks for that idea," or "I never thought of it that way."
- Avoid asking questions that have "pat" answers.
- Toward the end of a discussion, ask participants to summarize the points that have been made.

Generally, these suggestions aim at stimulating person-to-person interaction with as little direct facilitator involvement as possible. This role is important for successful discussions and individual growth in dealing with ideas and issues. Initially, some participants may have difficulty reacting without specific direction. However, the initial, uncomfortable phase of long silences and faltering responses is essential to stimulate each student's ability to evaluate her or his own ideas and values.

V. TEACHING CONSIDERATIONS

Activity-Specific Teacher's Guide Pages

For each activity there is an activity-specific teacher's guide page. These guides are designed for you to use on a daily basis in your planning and to assist your students as they progress through the activities. Each teacher's page is divided into eight parts: Focus, Objectives, Additional Opportunities, Materials and Advance Preparation, Teaching Considerations, Guide to Class Discussion, Going Further, Self Check Key and New Words.

The Focus provides the broad goal or idea that the activity is designed to treat. The list of Objectives and Additional Opportunities summarizes the learning opportunities available to students who complete this activity. Students will differ in the degree to which they realize the objectives due to the choice components in many activities and the differences in interest and attitudes.

The Materials and Advance Preparation section provides a list of materials both you and/or your students will need to complete an activity. This section needs to be read several days prior to the initiation of an activity.

Teaching Considerations contain instructional suggestions, cautions, background information and alternative approaches. The information provided in this section is essential to the success of an activity. Teachers should read this section prior to introducing an activity and try to incorporate the information into their instructional plans. You may find the need to include additional information within this section as you teach the unit. Writing additional considerations will help those teachers who plan to use the module again.

The Guide to Class Discussion section is designed to help you facilitate class discussion that will highlight and augment student's knowledge about the concepts taught in each activity. Students will differ in the degree to which they are able to conceptualize the ideas in Genes and Surroundings. You can use this section of each activity to determine how well your students understand the basic concepts presented. Some students may grasp only parts of the concepts presented. You may find that some are unable to understand or verbalize abstract ideas. You may also find that some students are able to conceptualize abstract ideas in one activity yet in another activity they have difficulty with this process. Your class discussions can be very helpful in providing clues to the level of cognitive development of individual students. When students are answering the discussion questions, do not expect them immediately to discover the "correct" answer. The process of considering different ideas and beginning to think abstractly is more important at this stage of a student's development than is a student's ability to always answer "correctly." The discussion questions in the student materials have been designed with this process in mind.

Going Further suggestions are provided in each activity. These suggestions are designed to give students opportunities to expand their experiences provided in the body of the activity. You should think about these suggestions carefully when you are considering limiting or extending individual activities.

A Self Check section is provided in each student activity. This contains questions which students can use at the end of an activity. The questions highlight the concepts covered in that particular activity. It is suggested that these questions be used as a means of self-evaluation rather than as a "testing" situation. Keep in mind different students will have varying degrees of success depending upon their interests and abilities.

Words which may be new to your students are listed at the end of your teacher's guide to individual activities. These words will be found under the heading of New Words. Attention should be given to make sure students have an understanding of the meanings of the words. It is strongly recommended that students not be tested on definitions but that efforts be directed to providing contextual meaning.

A Test Item Bank is provided to assist you in developing tests. Use tests to evaluate your own performance and the adequacy of the materials. If, for example, many students missed an item covering an area you thought had been well developed, your reaction should be that either the materials or the teaching failed to illuminate the topic. Could the area have been approached in another way? Teachers using an examination to ask such questions of themselves will ultimately improve their teaching. Similarly, if students were exposed to certain materials and failed to achieve a given objective, could the materials have been at fault? If so, how could they be improved? Or, does a particular segment need more explication by you?

Give tests immediately after a concept has been taught, when students are most likely to answer questions correctly. Short tests, as part of the lesson, give students a chance to use what they have just learned. This procedure gives them immediate satisfaction when they are right and immediate corrective feedback if they miss an idea. Each time, reinforce the learning by discussing each of the answer choices.

Every test should be a learning experience. Students are anxious to know how well they have done on tests. As soon as possible (the same period, if practical), review the examination with the students. Discuss each question and encourage them to indicate why they gave the answers they did. When students have approached a problem logically and reasonably and have come up with incorrect answers, it may be more the fault of the test than the students. By reviewing questions when student motivation is high, the test becomes a learning experience rather than a grading one. Until the test has been reviewed with students, do not attempt to assign grades, if indeed a grade should be assigned at all. Give short tests frequently. Longer tests, given at infrequent intervals, leave no chance for remedial action when a topic is found to have been poorly comprehended.

For most students, the reward for accomplishment is a "good grade." They should not be deprived of this opportunity to realize success. But goals must be set that each individual can achieve according to her or his interests and abilities. Do not use the same meterstick to measure each student. Know your class and their individual strengths and weaknesses.

Test results must be viewed within the context of the total process of evaluation or their meaning is likely to be lost. If you establish valid objectives consonant with the skills and abilities of your students and if your tests measure these objectives, most of your students will be successful. When there is a significant difference between a student's test performance and your opinion of her or his ability, look seriously at your objectives, your methodology, or your evaluative devices.

Test scores will indicate areas that need to be retaught. Students should be aware that "missed ideas" will receive your attention also. Second or even third tests or quizzes should be given before grades are assigned. To encourage learning, select alternate items or tests with a varied format and give your students a second chance to correct missed ideas.

ACTIVITY 1

NO TWO ALIKE

FOCUS

Every person is unique.

OBJECTIVES

Students will have opportunities to

1. investigate individual variation using fingerprints.
2. compare their own fingerprints to four basic types.
3. compare the fingerprints of relatives.
4. answer questions about the uniqueness of every person.

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. compare their fingerprints to those of other students..
2. solve a mystery using fingerprints.

MATERIALS AND ADVANCE PREPARATION

The materials needed for each student or team of students doing this activity are:

stamp pad (more than one) See Teaching Consideration #4 for alternatives.
index cards (unlined 5" x 8")
magnifying glass

Assign card making as homework before the classwork in this activity.
Collect enough stamp pads or alternatives for students to take home.

NOTE. If students are unable to fingerprint their own family members, they may choose another family to fingerprint and compare the similarities and differences.

(This activity may require two periods.)

TEACHING CONSIDERATIONS

1. Students are asked to record their fingerprints and those of their relatives. As students compare fingerprints to the four basic patterns and then to each other, they can see the uniqueness of each individual. Special encouragement may be needed to facilitate parent cooperation. Students should be able to observe that blood relatives have more similarity in fingerprints than do non-relatives.

2. Remind students to print all of a fingerprint. You may want to provide soap, water, and paper towels in the classroom for use when students need to clean the ink from their fingers. If it is not possible to use ink, soap, and water in the classroom, students may press their fingers against a chalkboard. An impression will be left which may be compared with other fingerprints.

3. Time saver: Have students make their cards as homework prior to the activity, or record prints in book, if books are not going to be reused.

4. Alternatives to stamp pad: Shoe polish, eye liner, mascara, chalk, grape juice, etc., can be used to replace stamp pad and ink. Transparent tape can be used to prevent smears on the card.

GUIDE TO CLASS DISCUSSION

The discussion questions are designed to help students realize that no two people are exactly alike. Fingerprints are used as an example of this uniqueness.

KEY TO DISCUSSION QUESTIONS

1. Fingerprint patterns should be more alike in blood relatives. A large sample size may be needed to show this similarity. Small class size may cause difficulties in illustrating more similarity between relatives than in non-relatives.

Alike: prints have same general design--ridges.

Different: each person has their own unique design, for example, number of ridges.

2. Fingerprints can be used to identify people, by police, the military, hospitals, for autopsies, birth records, etc.

3. There are four basic patterns for fingerprints. Each person has a unique set of fingerprints that is a variation of these four basic patterns. (A person may have one or more of the basic patterns in his or her prints.) No two people have fingerprints exactly alike.

GOING FURTHER

Students may further explore the uniqueness of individuals by comparing their fingerprints to those of other students. Similarities and differences can be noted and discussed. They may also try to solve a mystery using fingerprints. A game can be invented in which students try to determine who is the best detective. Making unique artistic designs could become an extension of this activity as students experiment with their fingerprints.

SELF QUIZ KEY

1. Drawings will vary. However, the drawing should resemble the four basic types of fingerprints.

2. b. Fingerprint patterns do not change throughout a person's lifetime. Scars, etc., may cause some differences in the fingerprints, but these changes will not alter the pattern. Even identical twins do not have exactly the same fingerprints. The more closely related two individuals are, the more similar are their fingerprint patterns. Identical twins show the most similarity.

ACTIVITY 2

ANOTHER YOU

FOCUS

Students examine their awareness that development is influenced by genetics and environment and that some values relating to development are culturally derived.

OBJECTIVES

Students will have opportunities to

1. identify personal attributes they consider desirable.
2. graph data collected by questionnaire.
3. analyze variation in personal perceptions about which characteristics are most desirable.
4. recognize cultural influences affecting personal perceptions of desirability.
5. identify characteristics influenced by genetics and environment.

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. investigate the influence of the media in fostering notions about desirable characteristics.
2. consider personal or environmental characteristics and how they might be changed.
3. investigate the relationship between lifestyle and attitudes about desirable characteristics.

MATERIALS AND ADVANCE PREPARATION

Each student will need the following materials:

6 paper squares, 2 cm on each side (These can be made by students or teacher or can be brought from home. See teacher consideration #5.)
sheet of 1 cm grid graph paper (Can also be made by teacher.)
ruler

(This is a two day activity.)

TEACHING CONSIDERATIONS

1. In this activity students are requested to make personal evaluations of the desirability of specific characteristics. To assess individual perceptions, the procedure allows for the anonymity of each person's choices. Encourage students to keep their choices to themselves, at least until the choices are tallied. High ability students get bored with numbers of graphs. Delete some of them. Some may be deleted to save time. Graphs may also be made by teams.

2. Provide six labelled containers in which to collect the written choices. Students should circulate these containers to collect responses for each characteristic.

3. To tally the choices, assign students to sort and count the choices for each characteristic. Six students or groups could be sorting simultaneously. While this occurs, the remainder of the class should be preparing on graph paper the axes for six histograms. Extra graph paper should be provided if the scale of the graphs needs to be enlarged. This may allow more students to be involved in the construction of the histograms.

4. When the results have been tallied, call out the characteristic and totals for each choice. Have students mark the top line for the representative bar as results are read. NOTE: Students may need a demonstration illustrating how to mark the representative bars.

5. To save time you may assign making of squares as homework or mimeograph the graph paper and cut the squares. Time can also be saved by mimeographing the bar graphs to be filled in by the students.

6. For classes where graphing may be extremely difficult, an option is to have each student make a list of choices. These choices may be tallied and put onto one large graph.

GUIDE TO CLASS DISCUSSION

Discussion questions have been provided in the student materials to assist students in thinking about what influences their idea of desirable characteristics. During the discussion focus on the variations in the choices and the factors that influenced the variations. Answers will vary, yet an effort should be made to stress the ideas that genetics and environment influence human development and that culture, fad, and personal preference influence our values.

GOING FURTHER

1. Suggestions for further investigations are made for interested students. Students are encouraged to investigate influences of media on their ideas of desirable characteristics. Historical ideas and analysis of current lifestyles provide opportunities for analysis of the ways culture affects attitudes.

2. Magazines may be used to find how "ideal" or "perfect" people are portrayed. Emphasize how we are influenced to think we aren't OK when we really are.

SELF QUIZ KEY

1. Answers will vary. Look for student awareness of various influences on their attitudes. Possible answers include: the way other people look and behave, T.V., magazines, parents, etc.

NEW WORD characteristic

ACTIVITY 3

SOMETHING OF VALUE

FOCUS

Each person has special talents that can be important to herself or himself and to others.

OBJECTIVES

Students will have opportunities to

1. think about their own talents.
2. think about talents that their classmates have.
3. think about ways to use talents in helping themselves and others.
4. play a game in which the contribution of every person in the class is necessary to solve a problem.
5. answer questions about the value of having different talents in a group of people.

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. read stories about famous people and how they used their special talents.
2. read human interest stories from current literature to see how people use their special talents.
3. create their own "mystery" to solve by sharing their personal clues.

MATERIALS AND ADVANCE PREPARATION

A set of Mystery Clues will be needed by each student or team of students who performs this activity. The Mystery Clues will need to be cut apart before class begins. Lists may be photocopied if more are needed.

Copies of clues.

Go over directions for solving Ann's class schedule with your class before they begin to work on the solution.

TEACHING CONSIDERATIONS

1. The important idea of this activity is that everyone has some type of talent that is useful to that person and to others. Some students may feel that they do not have any talents or that their talents are not as valuable as someone else's. Encourage students to think about the talents that they do

possess and how they can be used. Be sensitive to handicapped or mainstreamed students and insure that they list talents and discuss their value; insist everyone think of some talent they possess.

2. The Mystery Clues can be used to discuss the value of everyone having different information and the important contributions that such differences make to the whole group. Encourage students to discuss the similarities of having different talents and having different clues. Ask students what would happen if someone who had a clue decided not to participate? How would this help or hinder finding the solution to the problem? See Going Further #2 for additional suggestions.

Key to mystery: Ann's schedule, periods 1-7 inclusive: P.E., math, English, history, lunch, art, and science.

GUIDE TO CLASS DISCUSSION

The questions for discussion have been designed to stimulate thought about the value of having different types of talents. Encourage students to discuss what happens when individuals do not share their talents with the whole group. This is a good opportunity to discuss the value of all people and the benefits of variety. The answers to the questions for discussion will vary with each group of students. Allow ample time for the students to express their ideas about their own talents. Many students at this age are insecure and have low self-esteem. Opportunities to enhance self-image should be encouraged.

GOING FURTHER

1. Have the students read stories about one or two famous people (for example, Elton John and Loretta Lynn). Discuss or list the special talents that may have been influenced by their environments. What caused the people to do what they did to become famous? List other factors that may have contributed to their lives today, i.e. Loretta Lynn's husband's drinking problem influencing her songs; Elton John's flamboyant stage dress versus the way he really lives. There may be aspects of these or other famous lives the students know about and can share with the class. Constantly remind the students to look for special talents and ways they were developed.

2. The story on pages 9 to 11 may be used as an additional "mystery" to assist students in developing communication skills. The sentences in the story are numbered. Make a copy of the clues for each group. Cut apart the numbered sentences and refer to them as "clues." Give each group a complete set of clues. Have the students draw their clues from a box or other container. Go over Directions in the student's book with your class.

Your behavior is important to the success of this activity. As you read the instructions with the students, avoid giving additional guidance. This activity is more successful in an atmosphere of suspense. It also requires an informal setting. After you have gone over the Directions, sit down and wait quietly for students to discover how to proceed. Do not be upset by talking and a somewhat noisy classroom.

All of the students must cooperate to put the story together and identify the mystery "shadow." To complete the activity successfully, students will

have to

- a. Elect a leader.
- b. Allow the leader to represent them in discussions with you and among the group.
- c. Cooperate in devising a plan for putting the clues together. (Put the clues in numerical order.)

Allow students to "discover" they must choose a leader to represent them. (You can do this, when a student asks you a question, by responding with "Are you the one person from your group who will be asking me questions?" If the student has not been duly elected, do not answer the question. Do not provide any additional ideas or suggestions.) Students may take from 10 minutes to the entire class period to solve the mystery. Some groups never solve it because they cannot communicate with each other or are unable to follow a leader. Have patience with the process.

When a group of students has solved the mystery, the leader should describe the story line to you and tell who is the "shadow." Whether your students solve the mystery or not, you can discuss the value of working together as a group as opposed to everyone's acting individually. If the group was successful in solving the mystery, ask them why they were successful, what did each student contribute, what steps did they take as a group and as individuals to solve the mystery. If the group was unsuccessful, ask them why they think they failed, what they might have done, as individuals and as a group, to solve the mystery.

Help your students to recognize the special contributions that can be made by every individual and the benefits of elected representatives. Relate the "clues" in the mystery to individual talents that can contribute to solving real-life problems through group cooperation, with everyone contributing some effort. Examples are planning a school dance, keeping a house clean, or setting up a "bucket brigade" to put out a fire.

SELF QUIZ KEY

1. Answers will vary. Ideas about the value of having different talents should be discussed with students.

NEW WORDS

none

THE SHADOW

Mystery - What is the mysterious "Shadow"?

1. Every Halloween Cathrine and Lois would order pizza and soda from their local pizza shop.
2. Lois would always let Cathrine choose the kind of pizza.
3. She really was a nice sister most of the time.
4. After eating their pizza, Lois let Cathrine hand out treats to the evening neighborhood visitors.
5. All the neighborhood kids knew Cathrine would be there at her door ready to share special treats her parents had prepared for this evening.
6. Every year after all the visitors had departed with their treats, Lois would let Cathrine spend the night in her room.
7. Lois would exchange rooms with Cathrine for this one night.
8. This was a great treat for Cathrine because she loved Lois' room.
9. This evening after all the kids had visited, Lois helped Cathrine get ready for bed.
10. She stacked two chairs by the bed and carefully hoisted her up.
11. Cathrine was very happy.
12. As Lois turned out the light, she peacefully snuggled into the covers and began remembering the evening's events.
13. Suddenly, something seemed to change.
14. Cathrine felt a chill pass through the room.
15. She looked out the bedroom window, past the back fence, into her neighbor's yard.
16. She thought she had seen a shadow move across the neighbor's window.
17. She grew very still and silent.
18. Had she imagined the shadow?
19. No.
20. There it was again.
21. It was in the neighbor's yard.

22. It moved.
23. It moved behind that bush.
24. Silence.
25. Nothing.
26. There it was again.
27. It moved behind the tree.
28. Cathrine could hardly believe her eyes.
29. Her heart seemed to be making enormous sounds.
30. She almost stopped breathing.
31. She stared into the darkness, seeing only the shadows made by the moonlight falling on the trees.
32. There it was again.
33. Yes, it was.
34. It was a man's shadow.
35. She saw his outline clearly.
36. He looked into her neighbor's window.
37. He moved slowly, slowly to the back porch.
38. He tried to open the back screen door.
39. It was locked.
40. He moved to the window and tried to push it open.
41. It didn't budge.
42. Quietly, the figure moved around the house and slowly melted into the surrounding shadows.
43. Cathrine tried to scream, but no sound came from her lips.
44. She buried her head into her pillows and tried to calm down.
45. Slowly, slowly, she fell asleep.
46. When Cathrine awakened in the morning, she suddenly sat up in bed and thought, "I must tell Mom and Dad what I saw last night."
47. She jumped from the bunk and quickly ran to the breakfast table.

48. "Mom, Dad, someone tried to break into the Williams' house last night."
49. "Yes, we heard about the big break-in attempt," said Dad and laughed.
50. Cathrine was puzzled.
51. Why was Dad laughing?
52. Dad continued, "Bob Williams came home from college last night."
53. "His parents' house was locked."
54. "Bob tried to get in the house without alarming the neighbors."
55. "But, he couldn't get in."
56. "So, he went to a friend's house and spent the night."
57. "He came home this morning with his story about their nighttime visitor."
58. Little did he know that his watchful young friend knew all along.
59. Or did she?
60. Cathrine smiled.

ACTIVITY 4

WHAT DOES IT TAKE?

FOCUS

Different people are good at different things, and talents often go hand-in-hand with interests. Personal, cultural and social environment greatly influence the development of interests and talents.

OBJECTIVES

Students will have opportunities to

1. think about how physical, personal, and environmental characteristics influence talents.
2. listen to the teacher read a story about a boy and how he developed his special talents.
3. think about some of the characteristics that made the boy a good swimmer.
4. answer questions about talents and how they may be developed.
5. think about characteristics and how they match talents by writing a story about a person with a special talent.

ADDITIONAL OPPORTUNITY

Students will also have the opportunity to read about a famous person and the way he or she developed a special talent.

MATERIALS AND ADVANCE PREPARATION

1. Read Manuel's story, think of alternative environments in order to anticipate reactions.
2. Spend some time discussing what physical, personal, and environmental characteristics are.
3. You may wish to (1) invite a public library representative to demonstrate the use of the Com-Cat, explain how to get a library card and use the public library, (2) show where various magazines feature personalities each month. Seventeen, Essence, Time, Newsweek, Boy's Life, Life, and Ebony are some of the sources available in school and neighborhood libraries.
4. Encourage students to bring paper and pencil to class so they are ready to compose a story about Manuel in a new environment.
5. Read Teaching Considerations and Guide to Class Discussion before beginning the activity.

TEACHING CONSIDERATIONS

1. Some students may feel that they have no talents. It is important to point out that everyone has some talent that is pleasurable to the person and important to others. Be sensitive to the needs and problems of handicapped children in mainstream situations. Such students have talents and are successful; otherwise, they would not be in the school situation. Encourage students who lack confidence and self-esteem to consider their total life situations and identify their own special talents. They will be good at certain things they do in school, at home, in sports, in church, or in interactions with their friends.

2. Students differ in their abilities to understand and use category schemes like the ones presented here. Precise categorization is less important than the creative activity of thinking of as many relevant factors as possible. Make sure that ample discussion goes on, both in small groups and as an entire class, so that students who are unable to think of very many factors on their own have a chance to hear a variety of ideas from their classmates.

3. In common parlance, "environment" often means only the physical environment--air, water, land, and so on. Remind students, if necessary, that each person's environment also includes social factors (the people and institutions around you and how you interact with them). Examples of this should be obvious in the story "Manuel." Manuel's interactions with his family, his coach, his school, and his friends are as important to his talent as his own natural ability and the availability of physical facilities. This point should come out in discussion of Question 1 in Questions for Discussion I.

4. Allow ample time for Part II. It is a creative activity that, if done well, requires considerable thought and work on the part of the student.

5. If, in the student's rewrite of Manuel's story, Manuel's talent changes, his new talent is to be written on the line provided.

GUIDE TO CLASS DISCUSSION

The questions for discussion have been designed to stimulate thought about different characteristics necessary for developing special talents. Allow students to formulate their own ideas and to discuss them fully with other classmates.

The answers to the questions will vary. Encourage students to consider "what it takes" to develop different talents.

Several questions may lead to suggestions that will counteract some notions of bias or prejudice. For example, although the story does not specifically mention Manuel's ethnic group, his name suggests that he is Spanish-American. Manuel's ethnic background does not have anything to do with his swimming ability. Questions of whether boys or girls are better at certain things may also arise. Be alert to sexual or racial stereotyping. If necessary, ask probing questions that will reveal, and, if possible, dispel such stereotypes.

GOING FURTHER

Students are encouraged to read about a famous person as they expand their considerations of "what it takes" to develop different talents. A lively exchange may result from questions centered around the physical, personal, and environmental characteristics of the different people that are discussed. Refer students to the series by Charles and Ann Morse referred to in the previous Activity.

SELF QUIZ KEY

1. A

Use the story and questions under Part II to determine whether students have been able to identify relationships between developed talents and environmental influences.

NEW WORDS

physical
personal
environmental

ACTIVITY 5

GENERATIONS

FOCUS

Students use a simple model system to show that "some things" (genes) are transmitted from generation to generation.

OBJECTIVES

Students will have opportunities to

1. simulate the transmission of genetic information from grandparents to parents to children.
2. collect and interpret data on the diversity of patterns possible from such transmission.
3. relate the physical attributes of humans to the genetic information received from previous generations.

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. collect, graph, and interpret data on the probability that any one gene will be transmitted.
2. consider the classical genetic puzzle "Like begets like--but not exactly alike."

MATERIALS AND ADVANCE PREPARATION

Each student or team of students will need:

24 jelly beans: 6 red, 6 green, 6 yellow, and 6 blue (You might wish to use buttons, poker chips, or other objects. Jelly beans are somewhat expensive and students might not be able to resist eating them before the activity is completed or before you have an opportunity to complete the activity with other classes.)

6 paper cups

felt marking pen (black)

felt marking pens in the same color as the jelly beans (Crayons or colored pencils can be substituted for marking pens.)

As an alternative to the use of paper cups, you might cut out the circles and squares for the pedigree on p. 23 (five circles and five squares). The pedigree can then be labeled and reproduced on the student's desk or tacked to a bulletin board.

TEACHING CONSIDERATIONS

1. This is the introductory activity in the section GENERATIONS (Continuity). It is intended to establish a context for the rest of the section in which students examine the nature and implications of the transmission of characteristics from parent to offspring. In this activity students should begin to develop an understanding of the fact that observable differences in individuals, families, and populations result largely from the transmission of genetic information from one generation to the next. In subsequent activities in this section, students will examine the mechanisms of transmission and the impact that heritable characteristics can have on an individual's health status.

2. The activity may be done by individual students, or by teams of two or three students working together. Following the patterns of inheritance of genes represented by jelly beans may help students become acquainted with the standard forms and symbols of pedigree charts (see FAMILY TREES AND TRAITS). Coloring the "genes" gives a visual representation of those "somethings" that are passed from generation to generation. Other activities will help students learn more about what genes actually are and how they are transmitted.

3. This activity introduces some simple notions of probability (see, for example, Part I in Going Further). Some students may be ready for such ideas, while others may not be able to achieve real understanding of such a complex idea. The point of the activity is made if students simply come to have some idea of transmission of genetic information across generations. Do not be overly concerned if the more difficult points about probability are not fully developed.

4. Students should understand that although all the genes (jelly beans) are the same in the members of the first generation (the grandparents), that is not the case in reality. You should explain to the students that this has been done simply to demonstrate how genes are distributed through successive generations. Also emphasize that humans have more than six genes.

5. Some students may have no experience with tallying, which is required in Part I of Going Further; you should review this procedure if necessary. Time constraints may preclude completion of twenty repetitions in Part I of Going Further. You can reduce the number of repetitions, but fewer than 10 repetitions might not yield sufficient data for interpretation of the bar graph.

GUIDE TO CLASS DISCUSSION

Each of the questions in this activity is designed to stimulate discussion. In most instances, answers will vary and will depend upon the student's own ideas or data.

QUESTIONS FOR DISCUSSION

1. It is unlikely that any of the four children had exactly the same genetic complement. However, it is possible. Students in groups where identity did occur might be reminded that results would have been different if they had used many hundreds of beans. They might also notice that duplication was rare in the

data collected by other individuals or teams. It doesn't happen very often because there are too many chances for different combinations.

2. Students may understand that half of the genetic information in a new individual comes from the father and half from the mother. This idea is further developed in the reading that begins on page 26.

3. This is a subtle point, and some students may have trouble understanding the reason. The simplest explanation is that the parent does not lose genetic information with each child conceived or born. Rather, the parents' genetic information is retained and copied when sperm and egg cells are formed. Therefore, to make our model represent real life, we have to return the genetic information to the parent, so it will be available for the next offspring.

4. Answers will depend upon the data the students collected. Accept all logical responses. Some students may be able to postulate: "If red genes made red hair, and Sarah got red genes from her grandfather, she would look like him." or "Sarah and Hugh have many genes the same, so they might look a lot alike."

GOING FURTHER

Part I

1. The heights of the bars will be different due to the probabilities of selecting various combinations of genes.
2. Each of the statements, a-d, is true.
3. No. The chances of selecting a red bean would have been greater.

Part II Questions for Discussion

Students may have difficulty expressing their ideas about "alike, but different." Allow for variation in the answers. If students can express ideas about variation in the same species the point is made. For example, for question 1 students might respond, "Humans produce humans, but they are not exactly alike." For question 2, students might respond, "When thoroughbred horses mate, the foal is a thoroughbred, but may be darker, lighter, larger, or smaller than its parents."

SELF QUIZ KEY

1. Genes are tiny bits of genetic material that carry information from parents to their children. Genes can be found on chromosomes inside the nucleus of cells.

NOTE: Students may have difficulty understanding and expressing the abstract concepts of genes, genetic material, and nucleus. If students have the idea that genes are in cells and they are somehow involved in transfer of genetic material, the point has been made.

2. Each individual receives 23 genes from each parent.

NOTE: Students may ask why parents do not run out of genes if they are contributing them to their offspring. You may need to review meiosis with your students to be sure they understand the duplication of chromosomes.

3. A generation is a step in a line of descent--parents are one generation, children another. Students may give examples of generations here to demonstrate they understand this concept.

4. The horses would not be exactly alike. The horses might be different "kinds" of horses. Even if they were of the same breed, there would be differences brought about by the passage of different genes from the parents.

NEW WORDS

generations
genes
inheritance

ACTIVITY 6

FAMILY TREES AND CHARACTERISTICS

FOCUS

Students construct pedigree charts to show relationships among family members.

OBJECTIVES

Students will have opportunities to

1. observe how pedigree charts may be used to show family characteristics.
2. draw a pedigree chart of a family and compare their drawings to those of other students.

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. investigate the pedigree charts of famous families to learn about patterns of inheritance.
2. draw a pedigree chart illustrating family relationships.

MATERIALS AND ADVANCE PREPARATION

The following materials will be needed by each student:

drawing paper
ruler
circle pattern (nickel)
square pattern (2 cm sq.)

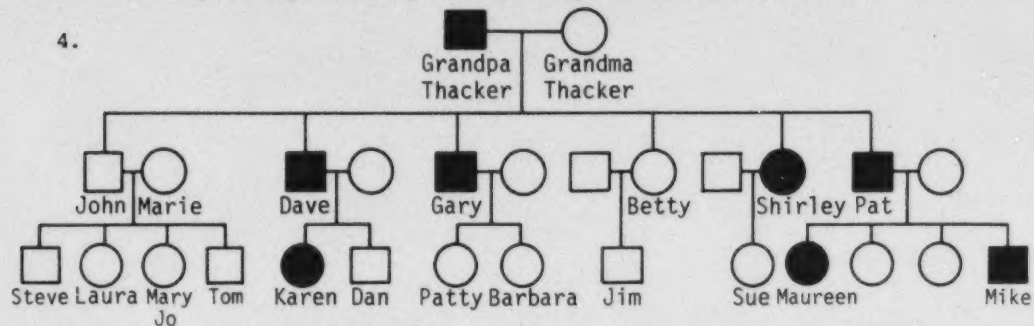
You might wish to cut out the 2 cm squares ahead of time and to have the resource books available for those students who will do the GOING FURTHER section of the activity.

NOTE: If using the student's own family pedigree is impossible or undesirable, use the pedigree in the Going Further section.

TEACHING CONSIDERATIONS

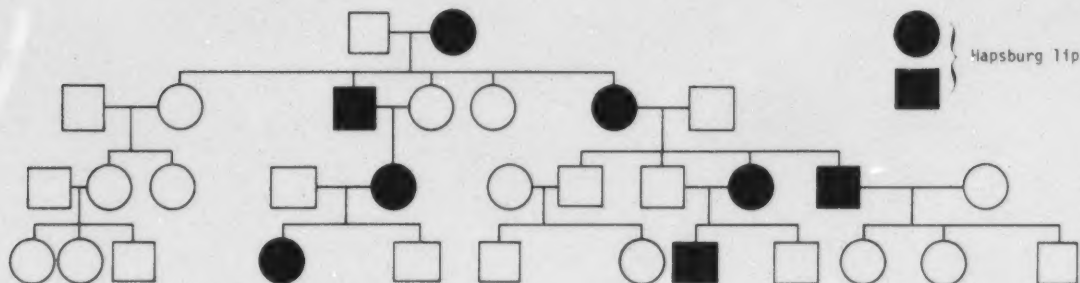
1. This activity reinforces the notion that characteristics are transmitted from generation to generation and introduces students to the process of constructing pedigrees. The activity demonstrates that the transmission of characteristics within a family can be recorded according to standard methods and analyzed to determine the pattern of transmission. This provides background

4.



5. Pedigree construction follows universally accepted conventions. The oldest child in a sibship, for example, is always on the left, next oldest second from left, etc. There is, of course, some room for flexibility, as long as special situations are noted in the key that accompanies the pedigree. This pedigree on the Hapsburg lip (a protruding lower lip with a narrow, protruding jaw) can serve as an example of pedigree construction.

HAPSBURG LIP--transmitted as an autosomal dominant trait

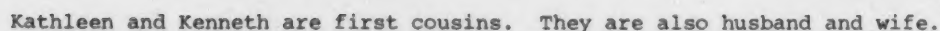


You may want to have a genetics reference on hand in case you need additional information on pedigree symbols to develop new activities, or in the event that students encounter situations or relationships for which symbols do not exist in the student book.

1. This question is designed to help students become aware of patterns of inheritance for characteristics. Students may have difficulty answering the three questions. Class discussion should provide clues to student's grasp of the information in this activity. Examples may need to be provided to show other patterns of inheritance. If students are aware that genetic material passes from one generation to another in an orderly manner, the point has been made.

GOING FURTHER

2. Information is provided for students to construct a pedigree. A key is provided:



SELF QUIZ KEY

1. B
2. C
3. Physicians or someone else in the medical profession might use a pedigree chart to show how a particular characteristic is inherited. Families often use pedigree charts to show relationships between family members.
4.
 - a. Gloria is Carol's granddaughter.
 - b. Carol and Ted are not genetically related; they are in-laws.
 - c. Richard and Kristin are brother and sister.
 - d. 3 (2 sons, 1 daughter)
 - e. Dorothy and Bob are father and daughter.
 - f. Maria and Charles are cousins.

NEW WORDS

pedigree
expressed

ACTIVITY 7

A CHROMOSOME IS...

FOCUS

There is an underlying pattern to human growth and development. This pattern is influenced by material contained in chromosomes.

OBJECTIVES

Students will have opportunities to:

1. recognize that there is an underlying pattern to everything about life.
2. explain basic facts about chromosomes.
3. analyze a human karyotype.

ADDITIONAL OPPORTUNITIES

Students also will have opportunities to:

1. analyze current news articles that feature news about chromosomes.
2. listen to an expert on cells, chromosomes, or genetics.

MATERIAL AND ADVANCE PREPARATION

1. Refresh memory on chromosomes, karyotypes, and cell division.
2. Invite someone from the local March of Dimes, genetics counseling centers, or other groups to speak to classes.

TEACHING CONSIDERATIONS

1. Ahead of time, ask students to watch for articles in newspapers and magazines concerning chromosomes.
2. Students may have difficulty with the concepts presented in this activity. Genes are not mentioned since students often have difficulty distinguishing chromosomes from genes. By dealing with the topics individually, students have a chance to separate the two concepts.
3. Do not expect all of your students to grasp the concepts immediately. The main ideas which students should obtain are as follows: there is something in each person that controls growth and development; chromosomes are found in the cells; and these chromosomes influence how people or other living things grow and develop.
4. In order to understand chromosomes, cells, and characteristics a review of the structure of cells may be needed. The reading, "Architects and Chromosomes," provides an explanation of this relationship. Encourage student discussion for further clarification of this concept.

GUIDE TO CLASS DISCUSSION

Answers are provided to the discussion questions to be used as a stimulus to class discussion. Discuss the students' wrong answers as well as the correct ones. Many of the concepts in this activity may be difficult for students to grasp. Do not insist that the questions be answered without assistance. Analysis of wrong answers can be especially helpful when used to clarify unclear or misunderstood information.

Part I

1. The two pictures both contain chromosomes.
2. The chromosomes are not the same in both pictures. Encourage students to list how the chromosomes are different.
3. Top 46, bottom 46
4. Answers will vary; however, ideas such as size, shape, and location of centromere will probably be described.
Size, shape
5. 2
6. 1,1

Part II

1. Chromosomes contain information that directs the behavior of cells.
2. Answers will vary. Any body function or behavior that is controlled by genetic information will be appropriate. Answers might include growth, getting rid of wastes, transportation of nutrients by blood, growth of hair, etc.

GOING FURTHER

Students have opportunities to investigate current articles about chromosomes. This may give students concrete information about the concepts presented in the activity. Encourage students to seek information and put it into their own words. Discuss the information with them in order to avoid possible frustration with the use of technical terms. Invite an expert (local pediatrician or obstetrician, genetic counselor, March of Dimes representative) to talk about benefits obtained from chromosome research.

SELF QUIZ KEY

Their responses will vary.

1. 46
2. In the nucleus of the cells
3. Instructions for building cells are carried in chromosomes. The chromosomes are found in the cell nucleus.
4. Accept any answer. Students will probably use such examples as height, facial features, body features, etc.

NEW WORDS chromosomes
 karyotype
 nucleus

ACTIVITY 8

SEX CHROMOSOMES

FOCUS

There are two kinds of chromosomes that determine whether a child will be male or female.

OBJECTIVES

Students will have opportunities to

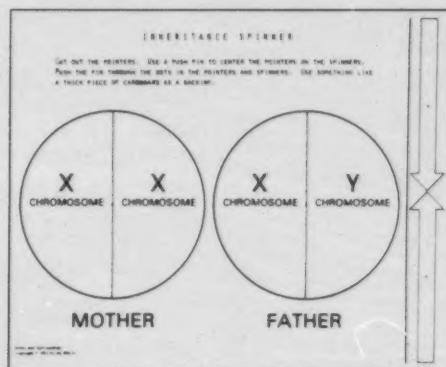
1. observe karyotypes to discover X and Y chromosomes.
2. observe transparencies of male and female karyotypes.
3. review information about egg and sperm combining to form fertilized eggs.
4. observe diagrams of the number and types of chromosomes in sex cells.
5. use an Inheritance Spinner to determine whether a child will be male or female.
6. think about how inheritance of X or Y chromosomes determined the sex of the child.

ADDITIONAL OPPORTUNITIES

1. Use the Inheritance Spinner several times and keep a record of the results to explore the probability of a child being male or female.
2. Contact local officials to obtain statistics about the birth rate of males and females in their area.

MATERIALS

Inheritance Spinner



transparency overlays: Sex Chromosomes (A, B, C)
scissors
push pins

ADVANCE PREPARATION

Secure overhead projector. Secure cardboard backing for Inheritance Spinners.

TEACHING CONSIDERATIONS

1. This activity begins to address patterns of inheritance--and their predictability--through an analysis of sex determination in humans. The notion of discernible patterns of inheritance is also addressed in later activities. The sometimes difficult--but central--concepts of probability are included here to communicate to students that there is some basis for analyzing and predicting how characteristics are passed from generation to generation. This activity is especially good for conveying the concept of independent probability. Stress the fact that each conception carries the same probability for a male or female offspring.

2. You might wish to cover or review meiosis before beginning this activity. Meiosis is covered in many other resources and, therefore, has not been included in this module. The intricacies of meiosis are difficult to understand and probably of little general utility for students at this level. Two concepts are central, however, to an understanding of inheritance: a) the reduction in the number of chromosomes from 46 to 23 in the gametes, and b) predictable patterns of inheritance and the range of probabilities associated with a given characteristic are the result of the behavior of the chromosomes during meiosis (in particular, first meiotic prophase); that is, segregation and independent assortment. It is important to emphasize that we can make certain predictions (based on probability) because we know a great deal about the way chromosomes behave during meiosis.

3. The main ideas presented in this activity are: Two kinds of chromosomes (X and Y) determine the sex of a child. Females contribute X chromosomes and males contribute X or Y chromosomes to offspring. The combination of chromosomes determines what sex the child will be. Extensive discussion may be needed for students to understand that both parents contribute sex chromosomes to the child, but that the father's contribution determines what sex the child will be. Use the overlays to show XX chromosomes in females and XY chromosomes in males.

4. A review of conception may be necessary before the concepts presented in this activity can be understood. Refer to the previous activity if a review is needed for the number of chromosomes found in human cells.

5. Class discussion should lead students to an awareness that there is a 50% chance that a child will be male or female. Stress the idea that each child has an equal chance to be male or female and that birth order does not affect sex of a child. The number of children that a couple has does not affect the sex of their next child.

6. Students may comment about the difference in size between the X and Y chromosome. This can be explained as a function of the amount of information contained on each chromosome. Many genes have been assigned to the X chromosome, whereas the Y chromosome seems to carry little genetic information--except of course for "maleness"--so far as is presently known. More advanced students

might wonder why the female does not have a "double dose" of information contained on the X chromosome. You might wish to discuss X-inactivation (the Lyon hypothesis) with these students. Information on X-inactivation can be found in any genetics text.

7. Students might be interested to know that in all mammals the female has two similar sex chromosomes (that is, the female is homogametic) and the male has two different sex chromosomes (heterogametic). In birds, however, the male is homogametic and the female is heterogametic.

GUIDE TO CLASS DISCUSSION

The discussion questions are designed to guide students to an understanding that both parents contribute to the sex chromosomes of a child. After class discussion of the questions provided, further discussion may be needed if students do not comprehend how the sex of a child is determined and the probability of each child being male or female. The transparencies can be used here to reinforce the concepts that each parent contributes half of the chromosomes to an offspring and that the X and Y chromosomes determine the sex of the offspring. Transparencies A & B = male karyotype; A & C = female karyotype.

KEY TO QUESTIONS UNDER DIRECTIONS

2. 46,X; X; 23
3. 46; XY; X or Y; 23
4. 46
6. Answers will be XX or XY, XX for girl and XY for boy.
7. 50% girl, 50% boy
8. XX, XY
9. Answers will vary.

QUESTIONS FOR DISCUSSION

1. 23, 23
2. X chromosome--mother, Y chromosome--father
3. X chromosome--mother, X chromosome--father
4. No, only the mother contributes an X chromosome to a son.
5. 50%
6. 50%

GOING FURTHER

For further reinforcement students are provided additional opportunities to use the Inheritance Spinner to determine the sex of a child. Local statistics will give information about the number of males and females born in your area. Students may also be interested in national statistics. National data show a slightly increased sex ratio in favor of males (approximately 51%). The reasons are currently unknown. Students may be interested to know that research has shown that sex ratios at birth can be influenced by the season of the year (there

are more males born in the late spring and early summer) and by the age of the father (there are fewer males born to older men). A particularly interesting observation--also unexplained--is that more males are born during war years.

Prenatal diagnosis now permits the identification of fetal sex, and research has long sought a method for selection of the sex of one's child at the moment of conception. More advanced students might be interested in discussing the possible effects on the male/female ratio if sex identification were widely available. This is a very sensitive area, however, and caution is advised--particularly in discussing prenatal diagnosis with students at this grade level.

This activity lends itself quite well to a discussion of X-linked inheritance. Going Further activities might include an analysis of a condition such as red/green color blindness or hemophilia. The Inheritance Spinners can be used in this activity. Simply designate one X chromosome as the one that carries the gene for the condition, and proceed as in the first part of the activity. Students will need to be informed that these are recessive conditions: females will generally have the "normal" gene on their other X chromosome and will, therefore, be unaffected. Males, however, because they have only one X chromosome, will be affected if they inherit the chromosome with the "abnormal" gene. Carrier females will produce (statistically) 50% carrier daughters and 50% daughters who do not have the gene at all. They will also produce 50% affected sons and 50% sons who do not have the gene at all. Affected males will produce 100% carrier daughters and 100% males who do not have the gene at all.

SELF QUIZ KEY

1. A
2. B
3. A

NEW WORDS

sex chromosomes
egg
sperm
fertilized egg

ACTIVITY 9

A MATTER OF CONTROL

FOCUS

Characteristics may be inherited in a dominant or recessive pattern.

OBJECTIVES

Students will have opportunities to

1. establish a concrete meaning of dominant and recessive using opaque and/or transparent plastic strips.
2. relate dominant and recessive to patterns of inheritance.
3. develop contextual meanings of dominant and recessive.

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. use reference material to discover how pedigree charts are used to show patterns of inheritance.
2. use reference material to provide extended opportunities for work with examples of dominant and recessive inheritance patterns.
3. choose their own letters to express dominant and recessive.

MATERIALS

The following materials are needed for each student:

construction paper (2 strips) 1 cm x 4 cm, or two strips (same size) of
dark or colored plastic
clear plastic (2 strips) 1 cm x 4 cm

NOTE: Cutting of paper and/or plastic strips can be done before class by teacher or students.

This lesson can be done as a teacher demonstration or a teacher-directed activity using colored transparencies and the overhead projector. Ask students for suggestions as to designations for the dominant and recessive genes. B for black and b for white may be confusing.

TEACHING CONSIDERATIONS

(NOTE: This activity may be omitted with advanced students. Review concepts of dominance and recessiveness with your students to determine if you should omit all or part of this activity.)

1. Review gene and chromosome definitions (Activity 7).
2. Students at the junior high level often have difficulty with abstract concepts. This activity provides concrete opportunities for students to explore

the concepts of dominant and recessive. Class discussions should provide as many opportunities as possible for students to explore the ideas of dominant and recessive.

3. Additional activities with examples of dominant and recessive characteristics can be found in high school biology or genetics texts. Readings about famous families and their characteristics can also be found. If students seem to have difficulty with the concepts of dominant and recessive, further examples may be used from biology or genetics texts before continuing to later activities.

4. Give every student a chance to manipulate strips for a "hands-on-experience." This can be done at their seats where they check each other, or at the overhead projector in front of the class.

5. Explain "crossed" as "mated with."

6. Emphasize that both males and females carry dominant as well as recessive genes. A characteristic may be dominant in one species yet recessive in another. Students sometimes think certain characteristics are always dominant.

GUIDE TO CLASS DISCUSSION

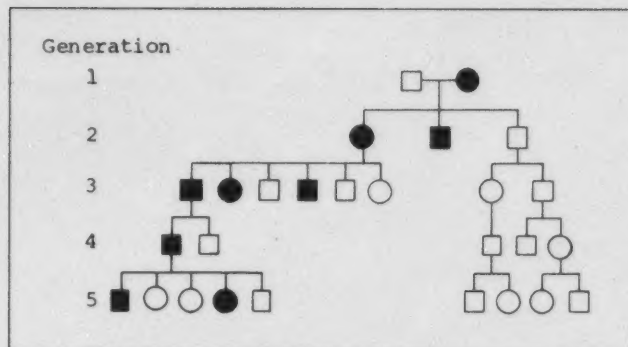
Questions are provided to allow students to develop contextual meaning to the terms introduced in this activity. A key to the student questions is provided below.

KEY TO CLASS DISCUSSION

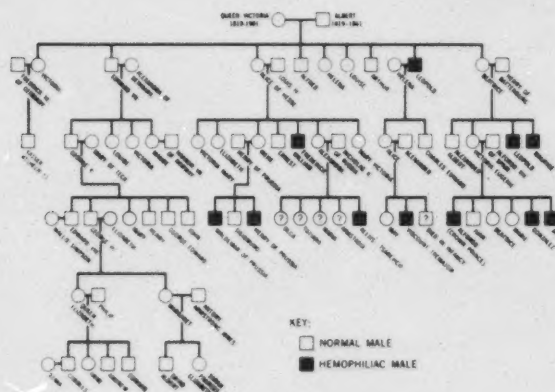
1. Yes, dominant genes are expressed in the living organism. The dominant characteristic is always expressed, unless there are two genes for the recessive characteristic.
2. Yes, a recessive gene is expressed when no dominant gene is present. A recessive gene is expressed when it is combined with another recessive gene of the same type.
3. The dominant gene is expressed over the recessive gene. The recessive gene can be described as "hidden."
4. BB, B, BLACK
Bb, B, BLACK
bb, B, BLACK
bb, b, WHITE
5. Black ones have B and b; white ones have only b.
Black babies: B mother, b father
White babies: b mother, b father
Mother's genes: B, b
If all babies are black, mother's genes are BB.

GOING FURTHER

Suggestions are made to provide further opportunities for students to obtain experience with dominant and recessive inheritance patterns. With reference materials, students should be able to develop contextual meaning for dominant and recessive. These pedigrees are provided in case students are unable to find information in their local libraries.



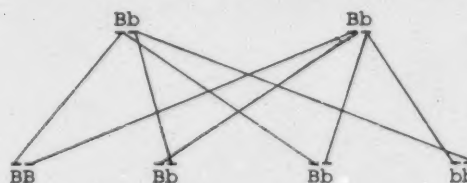
Pattern of an autosomal dominant trait



Pedigree of some of Queen Victoria's descendants, showing the hereditary distribution of hemophilia

SELF QUIZ KEY

- Answers will vary. Allow students the freedom to express their ideas about dominant and recessive in their own words. Students should be allowed to use examples to express their ideas. Formal thinking is often difficult for junior high students; therefore, they should not be graded harshly if they are unable to give extensive definitions to these two terms.
- The black dogs may have recessive (hidden) genes for white hair. If two recessive genes come together in the fertilized egg, a white puppy will be born. One or both parents of the black dogs could have had white hair, that would have made one or both of the black dogs have a recessive gene for white hair. This gene pairs up with another recessive gene in the puppy and it has white hair.



NEW WORDS

dominant: expressed even if only one gene of that type is present
recessive: not expressed unless two genes of the same kind are present
expressed: showing
crossed: mating

Others that might present reading difficulty:

ancestors
influence
combination
experimented

ACTIVITY 10

PREDICTING INHERITANCE

FOCUS

Students investigate the combination of genes that produces dominant and recessive characteristics.

OBJECTIVES

Students will have opportunities to

1. evaluate their understanding of gene action in producing single-gene characteristics.
2. distinguish between dominant and recessive characteristics.
3. interpret the expression of a characteristic from a gene combination.
4. observe unpredictability and variability in gene combinations.

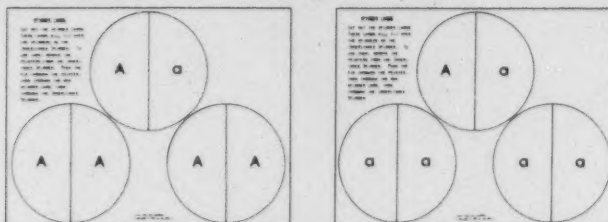
ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. further observe predictability for other single gene characteristics.

MATERIALS AND ADVANCE PREPARATION

Inheritance Spinner and 6 spinners are needed for each student or group of students doing this activity.



Advance preparation is not needed for this activity.

TEACHING CONSIDERATIONS

1. The characteristics included in this activity have been identified in Mendelian Inheritance in Man by Victor A. McKusick (5th ed., 1978) as being dominantly or recessively inherited. Many characteristics traditionally used as examples in the classroom, like tongue-rolling ability or ear attachment, are no longer thought to follow a single gene pattern of inheritance. Single

gene characteristics that cause genetic disorders have been avoided in this activity.

2. The characteristics have been chosen for instructional purposes. As research continues, different patterns of inheritance may be found for some of these characteristics. However, dominant-recessive patterns of inheritance can still be demonstrated by doing this activity.

3. This activity reinforces the concepts covered in Sex Chromosomes and A Matter of Control (Activities 8 and 9) and provides opportunities to predict the outcome of matings of individuals with given genotypes. It is important to reemphasize that chromosomes--and therefore genes--come in pairs, one of maternal origin and one of paternal origin. The genes that come from each parent for the same characteristic may be in a different form and are called alleles. Sometimes a change occurs in a gene or in a chromosome. These changes are permanent and are heritable. We call these changes mutations. Our knowledge of the way chromosomes behave and of the way genes are arranged on chromosomes enables us--using the laws of probability--to make predictions concerning the outcomes of various types of matings.

4. Make certain that students understand that dominant characteristics are present in males and females alike. Dominance is not equated with maleness, nor is recessiveness equated with femaleness.

5. The Going Further activities can be completed using Punnett squares rather than the Inheritance Spinners if you feel your students need more practice on the Punnett squares. The Going Further activities are also good opportunities to reinforce the probability approach used in Sex Chromosomes. For example, you might ask, "If the parents have the following gene pairs, what is the probability that their child will have...?" Question 9 on the Self Quiz is an example of such a question. Remember to emphasize that the probabilities are independent; that is, the same probability exists for each conception in that mating, regardless of the previous outcomes. Students should then begin to appreciate that certain types of matings result in predictable phenotypic ratios; e.g., two heterozygotes (Aa) will produce offspring (statistically) in a 3:1 phenotypic ratio: AA, Aa, Aa, aa--three with widow's peak and one with a smooth hairline.

GUIDE TO CLASS DISCUSSION

The concepts of dominance and recessiveness are sometimes difficult for students to grasp. The questions are designed to stimulate discussion. Allow extensive discussion of incorrect answers, since much may be learned from a discussion of why an erroneous idea was formed.

KEY TO QUESTIONS FOR DISCUSSION I

1. T; 2. T; 3. F; 4. T; 5. T

GOING FURTHER

Additional opportunities for practice with gene pairs have been provided. The chart under Direction 1 and the Inheritance Spinner will be needed for completion of this exercise. Students will need to make their own chart for recording and comparing their results.

KEY TO QUESTIONS FOR DISCUSSION II

1. T; 2. T; 3. F; 4. T; 5. F

SELF QUIZ KEY

1. mother; father
2. one
3. 75% (3 in 4)
25% (1 in 4)

NEW WORDS

Punnett Square

ACTIVITY 11

GENETIC CONDITIONS

FOCUS

Many genetic conditions exist; some of these cause medical problems.

OBJECTIVES

Students will have opportunities to

1. become aware of the existence of inherited conditions.
2. become aware that some inherited conditions cause problems.
3. read case histories about cystic fibrosis, Tay-Sachs, and sickle-cell anemia.
4. realize that some genetic conditions are more frequent in some racial groups than in others.
5. recognize that a knowledge of heredity can contribute to solving some medical problems.
6. become aware of dominance from parents of either sex.

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. investigate other genetic conditions.
2. see dominant and recessive patterns of inheritance.
3. read an article on genetic counseling.
4. have the opportunity to send for copies of forms to be used to keep their own medical histories. (This is optional. It is suggested the teacher send for the Medical History forms and make them available. Some will not want to do this.)

MATERIALS

None

ADVANCE PREPARATION

1. Call or write March of Dimes for Medical History forms.
2. Read the case histories and chart on page 58 in order to increase sensitivity to possible problems and anticipate questions.
3. For slow readers: choose one person in each group to be the reader. Others in the group may want to take notes.
4. Call local agencies to invite speaker(s) on Tay-Sachs, C.F., etc. They do an excellent job and make your job easier. The ethnic background of the class plus their interest might determine who you invite. Be sure to let speakers know age and grade of class(es) they will address.
5. You might begin the activity by asking, "Does any of you have or know anyone who has _____, _____, _____, or _____?" (Fill in the conditions you cover.) This will give you some feel for their involvement with the conditions covered. The school nurse should be able to tell you who in your classes is affected.

TEACHING CONSIDERATIONS

There are over 1300 conditions known to be inherited in a dominant or recessive fashion. At least another 1400 conditions are probably inherited in one of the same ways. Many of these conditions result in health problems. In this activity, students will look at three of the most common genetic disorders: cystic fibrosis, Tay-Sachs, and sickle-cell anemia.

The primary purpose of this activity is to help students to become aware of the existence of inherited conditions and to understand that knowing about inherited conditions can be of use in making informed decisions about personal and social issues and values. This general emphasis should not be lost by overemphasizing details of specific genetic conditions. It is more important that students in this stage of their development develop a positive attitude toward acquiring genetic knowledge rather than learning a great amount of details about specific genetic conditions.

1. Divide the class into groups of three. Each group should be assigned one of the case histories to read. There should be approximately the same number of groups working on each story. Let the students discuss the answers to the questions in their group.

When discussing these stories, the teacher should consider the following:

a. These are relatively common genetic conditions. It is highly probable that someone in your classes will have had personal experience with one of them. Sensitivity and tact should enter into all discussions.

b. The people in the stories are individuals first; the medical problem comes second. For this reason, terms such as "diabetic," "hemophiliac," "handicapped child" are not used. The preferred wording is "student with diabetes," "boy with hemophilia," "child with a handicap." Each of the people described is shown to fit into a family. When discussing genetics, it is easy to put so much emphasis on the condition that the person is forgotten.

c. The term genetic "disease" is not used. "Disease" has a negative connotation and it implies "catchability" to many students. The term "genetic condition" can be used instead.

d. The emphasis of the stories is not on genetic ratios. It is the intent of this exercise to give the student some idea of the biologic effects of a "malfunctioning" gene.

e. The term "carrier" applies to each of the stories. A carrier is someone who, while not expressing the specific recessive conditions has one gene for the condition. Carriers for sickle-cell anemia, cystic fibrosis, Tay-Sachs, and most other genetic conditions do not have any medical problems. It is likely that each of us carries some deleterious genes. When uninformed people say that, "Carriers of genetic disorders should not be allowed to reproduce," they are effectively suggesting that the human race come to an abrupt halt.

2. After students have completed the questions for discussion, have someone from each case history summarize the condition for class discussion. Points which should be brought up include:

- genetic conditions which cause medical problems are not rare.
- genetic conditions cannot be "caught" (like a cold).
- some genetic conditions occur most frequently in specific environments.
- people with medical problems are much more like everyone else than different.
- There is nothing wrong with being a carrier. A carrier does not necessarily have symptoms of the condition.
- there are carrier tests for some genetic conditions.

3. The genetic conditions selected for this activity are inherited in several fashions. Background information for each of the conditions is given below and is summarized in the following table. This information has been included to assist you in dealing with questions that may arise. The information is not intended as a basis for lecture or testing.

Condition	Increased Incidence In	Carriers Geno- (Pre- type frequency	Avail- ability of Carrier Test	Affected Geno- (Pre- type frequency	Involves	Treatment Available	Pattern of Inheritance
Cystic Fibrosis	Caucasians	Cc 1/20	Being Developed	cc 1/1600	Endocrine Glands	Treat Symptoms	AR
Sickle Cell Anemia	Blacks	Ss 1/10	Yes	ss 1/400	Red Blood Cells	Treat Symptoms	AR
Tay-Sachs	Jews	Tt 1/30	Yes	tt 1/3600	Central Nervous System	None	AR
Muscular Dystrophy (Duchenne)	No Particular Group	XX' 7	Yes	X'Y 1/5000	Skeletal Muscle	Treat Symptoms	XR
Huntington Disease	No Particular Group	No Carriers	n/a	Hh 1/25000	Central Nervous System	None	AD

A. Recessive Inheritance--Background Information

A recessive condition is one that is expressed when there is no dominant gene present. In order for the trait to be expressed, an individual must have two genes for that trait. Recessive means it would be hidden (not expressed) if a dominant gene were present.

Recessive characteristics have three things in common. These are:

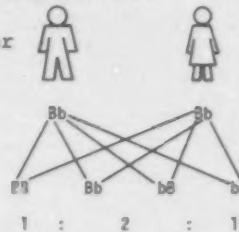
- Children expressing the characteristic can be born to parents without the characteristic.
- Equal numbers of males and females have the characteristic.
- For rarer conditions, there is often an increased incidence of people who are related to each other among the parents.

Some examples of recessively inherited human conditions are cystic fibrosis, sickle-cell anemia, Tay-Sachs, thalassemia, and phenylketonuria (PKU). Many recessive conditions are inborn errors of metabolism that involve enzymes. A recessive gene results in an abnormal or missing enzyme. A carrier for a recessive condition would be able to produce a sufficient amount of the enzyme with only one functional copy of the gene. It cannot be overemphasized that there is nothing wrong with being a carrier. Each of us carries some potentially deleterious genes.

The Mendelian ratios for recessive conditions are summarized below. These ratios apply to each conception. Each pregnancy is an independent event.

(Capital letter represents dominant; lower case letter represents recessive.)

- 1) One parent with the recessive condition, one parent with 2 dominant genes (BB x bb): 100% (all) children carriers (Bb)
- 2) One parent with the condition and one parent a carrier (bb x Bb):
50% (1 in 2) chance the child will be a carrier, (Bb)
50% (1 in 2) chance the child will express the condition. (bb)
- 3) One carrier parent, one parent homozygous dominant (BB x Bb):
50% (1 in 2) chance the child will be a carrier, (Bb)
50% (1 in 2) chance the child will not be a carrier, (BB)
- 4) Both parents carriers (Bb x Bb)
25% (1 in 4) chance that child will be neither a carrier nor express the condition, (BB)
50% (1 in 2) chance the child will be a carrier, (Bb)
25% (1 in 4) chance the child will express the condition, (bb)



B. Cystic Fibrosis--Background Information

No one knows what causes cystic fibrosis (CF). We do know that more than 2,000 children are born with cystic fibrosis in the United States each year. In fact, CF is the most common genetic disorder in the Caucasian population. About 1 out of every 20 white Americans is a healthy carrier of the CF gene. Thus, an estimated 10 million Americans are carriers of CF, but there is currently no reliable way to test for the carrier status.

CLINICAL SYMPTOMS. CF is probably an inborn error of metabolism. That is, there is probably an enzyme defect which results in a number of complex medical problems. Most of these complications are secondary to thickened mucous secretions which clog ducts and passages of the lungs, pancreas, liver, intestines, and other organs. Repeated episodes of lung infection slowly destroy the lungs, leading to respiratory failure. This slow destruction of the lungs places a serious burden on the heart so that heart failure becomes another concern. Obstruction of pancreatic ducts prevents digestive enzymes from reaching the small intestine. This leads to nutritional problems which affect growth and development. The sweat glands release an excessive amount of salt which can result in heat prostration. While about half of the children with CF die before the age of 20, there are more and more people surviving into young adulthood.

TREATMENT. There is no definitive treatment for CF. Instead, each of the symptoms is managed. The lungs are cleared of mucus by postural drainage. This involves positioning the child so that mucus will drain from specific lobes of the lung when shaken loose by gentle clapping motions. Physical activity also promotes loosening of mucous plugs which can then be cleared from the throat. In order to prevent/combat infection in the lungs, antibiotic treatments are used. Pancreatic enzymes are taken with each meal to promote fat digestion. Supplementary vitamins are usually recommended to fill nutritional needs. Individual complications are managed as indicated.

Of major concern is the child's psychosocial development. As with many chronic disorders, repeated hospitalizations, physical limitations, and decreasing stamina can have a significant negative impact on a person's self-image. In addition, the persistent hacking cough and slight stature often make children self-conscious when with their peers. The average annual cost for routine treatment of a child with CF has been estimated at more than \$10,500. The financial and emotional toll on the family can also be a difficult burden.

SCREENING PROGRAMS. Despite years of research, there is still no reliable carrier test for CF. Thus, a person's carrier status usually is not recognized until he or she has a child with the condition. The most frequently used test to diagnose CF involves detection of abnormally high salt concentrations in the sweat. Screening of all newborns is desirable but not feasible at this time. Prenatal diagnosis is an area of active and promising research.

C. Tay-Sachs--Background Information

Tay-Sachs is a recessive genetic condition that predominantly affects infants of eastern and central European Jewish (Ashkenazi) ancestry. Approximately one in thirty individuals of Ashkenazi background are heterozygous carriers of the gene for Tay-Sachs. Among the non-Jewish population the carrier rate is much lower, about 1 in 300.

In Tay-Sachs, hexosaminidase A, an enzyme needed for metabolizing specific lipids, is absent. These lipids accumulate in the brain and central nervous system, resulting in the gradual destruction of these cells and, ultimately, in death. A carrier of Tay-Sachs does not show symptoms of the disorder. One functional gene provides sufficient quantities of hexosaminidase A for lipid metabolism.

CLINICAL SYMPTOMS. Children with Tay-Sachs appear healthy until about six months of age. At that time, parents begin to notice muscle weakness and exaggerated startle responses to sound and movements. Acquired skills, such as crawling, sitting and grasping, are lost. As the brain cells deteriorate, the child continues to regress. Parents cannot elicit response from their child, and swallowing becomes difficult, necessitating tube feeding. Blindness, deafness and seizures develop. Many children are hospitalized to provide the intensive care that is needed. This downhill course continues and eventually leads to death by about 4 years of age. Watching a child die is devastating on the parents and family.

TREATMENT. Unfortunately, there is no cure or treatment for this disorder.

SCREENING PROGRAMS. Carrier screening has been available for Tay-Sachs since the early 1970's. This involves a simple, accurate, and inexpensive blood test. Hopefully, carriers can be identified prior to the birth of an affected child. With this in mind, most Tay-Sachs screening programs are directed toward young adults of Ashkenazi Jewish ancestry.

Prenatal diagnosis is available for Tay-Sachs. This involves measuring the hexosaminidase A levels in the discarded fetal cells which are found in the amniotic fluid. A couple may elect to terminate the pregnancy if the fetus is found to have Tay-Sachs. Genetic counseling is an integral part of all screening programs since it provides answers to the questions of worried parents and enables families to explore their options.

D. Sickle-Cell Anemia--Background Information

Sickle cell anemia (SCA) is inherited as a recessive condition; that is, the disease is present only in those individuals homozygous for the sickle hemoglobin gene. The medical problems of SCA can be traced to the sickling of red blood cells with subsequent blockage of vessels. This results in rapid destruction of red blood cells with subsequent impairment of oxygen supply to body tissue.

The range of medical problems associated with SCA is highly variable, as is the degree of severity. The following problems are common in patients with SCA: anemia, painful episodes, swelling of hands and feet in infants, nosebleeds, frequent urination, growth retardation, and delay in onset of puberty. Less common complications include pneumonia, gallstones, and ulceration of the ankles(1). Current literature suggests avoiding the term "crisis" in connection with painful episodes. In most instances, those episodes are not life-threatening, and can be managed with pain relievers. It is important to remember, however, that pain relievers do not eliminate the cause of the pain.

Early identification and better management of SCA have greatly improved the life expectancy of persons with the disorder. The large majority of children with SCA will live into adulthood and are capable of having families and leading normal lives. There are some special risks involved if a woman with SCA becomes pregnant, but good prenatal care can enable such women to carry a pregnancy to term.

School age children with SCA are generally seen by their physician every six months, unless there are complications. SCA children "should be treated as any other child, other than when complications are present... The amount of play activity the child engages in does not need to be governed or restricted by parents. Children learn when it's appropriate for them to stop" (2).

Sickle cell trait (SCT) is not a health hazard. Individuals with SCT have about 30-45% sickle hemoglobin; the rest is normal hemoglobin. SCT will be present in about 10% of those screened in the Black population. Screening for SCT and SSA has been highly controversial, because there was so much misinformation about the trait and because inappropriate -- and often detrimental -- decisions were made on the basis of that misinformation. For example, individuals were denied certain jobs and certain types of insurance, because they had been identified as having SCT.

Current screening programs help to avoid such misconceptions by providing sound educational programs for those screened and good follow-up counseling for those identified as having SCT or SSA. Most communities with large Black populations now have such screening programs. It may be helpful and interesting to have a representative from such a program address the class.

The benefit of screening and counseling for trait is the ability of individuals so identified to make informed decisions about marriage and child birth. (Since this is the primary benefit of trait detection, some geneticists see no need to screen persons under the age of fifteen.)

There is presently no cure for SCA. Good medical care can help control the effects of the disorder. There has been progress in the prenatal detection of SCA, using restriction enzymes to analyze the structure of the DNA in amniotic cells.

For further information on genetic conditions, see pages 44 to 49 for excerpts from "genetic counseling," published by the March of Dimes Birth Defect Foundation.

1. Whitten, C. F. A Primer on Sickle Cell Conditions in Children for Physicians, Pediatric Basics #22, Gerber Products Company, 1978.
2. Ibid.

GUIDE TO CLASS DISCUSSION

Student answers will vary based on the case study they read.

KEY TO DISCUSSION QUESTIONS

1. Answers will vary.
2. Answers will vary.
3. Answers will vary.
4. No. Genetic conditions cannot be "caught" from someone else. Unless someone has the genes for a condition, he or she will not develop the disorder.
5. Recessive
6. Answers will vary. Allow time for students to express their feelings about having a genetic disorder.
7. No. Only a few genes cause genetic disorders while all the other genes control our characteristics, most of which are without medical problems.

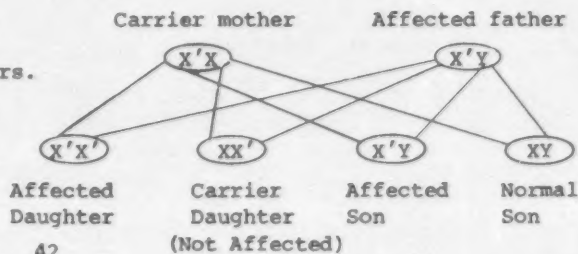
GOING FURTHER

Students are given an opportunity to obtain further information about genetic conditions. Suggestions are made about some of the more common genetic disorders that can be researched.

KEY TO GOING FURTHER QUESTIONS

3. This situation very rarely occurs.

Example of
X-linked
hemophilia



SELF QUIZ KEY

1. A knowledge of heredity can help a family or individual understand how a genetic disorder happened. This knowledge can be useful when dealing with feelings and when making decisions about family size. It can also be useful in making informed social decisions as a citizen.

NEW WORDS

cystic fibrosis

sickle-cell anemia

Tay-Sachs

hemoglobin

ethnic: of any groups of human beings who differentiate themselves from others on the basis of color, religion, or geography

heterozygous: having one dominant and one recessive gene for the characteristic in question

carrier: having a gene for the characteristic in question, but not expressing the characteristic; able to transmit that gene for the characteristic to any offspring

recessive: having a trait expressed when there is no dominant gene for the trait present. A gene characteristic not expressed in the heterozygous state. Two recessive genes must be present for the characteristic to be expressed.

family medical records

As scientists develop greater understanding of genetic mechanisms and environmental factors, they are better able to recognize how inherited traits interact with infections, medications, X-rays, drugs and many other influences before and after birth. This makes an accurate family health history more important than ever.

Such a record may be started at any time, but the ideal is before a family is planned, or even before marriage. Faithfully kept, it can be a useful diagnostic tool in all medical consultations, including genetic counseling.

Free *Family Medical Record* forms, with space for vital information covering three generations, are available from your local March of Dimes (see your phone book).

figuring the odds

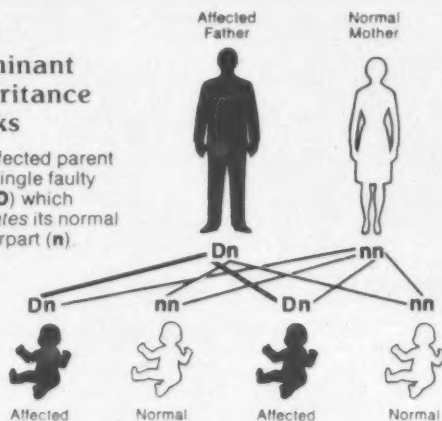
According to basic laws of heredity, greatly simplified here, genetic defects may be transmitted in varying degrees of severity from generation to generation in one of these ways:

DOMINANT INHERITANCE—An affected child usually has a parent with the same disorder. An exception would be a gene mutation, or change, in one parent's germ cell in a particular conception. In such a family, the parents would not have an increased risk of having other affected children.

If a parent has a dominant gene for a disease, there is a 50 per cent risk that each child will manifest the defect, though it may not be evident at birth. There is an equal likelihood that a child will *not* receive the abnormal gene, thus both he and his children should be free of the defect.

how Dominant inheritance works

One affected parent has a single faulty gene (**D**) which dominates its normal counterpart (**n**).



Each child's chances of inheriting either the **D** or the **n** from the affected parent are 50%.

Dominant diseases tend to show marked variability, with different individuals having different forms and symptoms of the same disease. Members of an affected family should be carefully examined for minor forms of the disorder. If such individuals are found to be normal, they will *not* transmit a dominantly inherited condition to their children.

Currently, 1,489 confirmed or suspected autosomal dominant disorders have been catalogued. Examples include:

- achondroplasia—a form of dwarfism
- chronic simple glaucoma (some forms)—
a major cause of blindness if untreated
- Huntington disease—
progressive nervous system degeneration
- hypercholesterolemia—high blood cholesterol levels,
propensity to heart disease
- polydactyly—extra fingers or toes

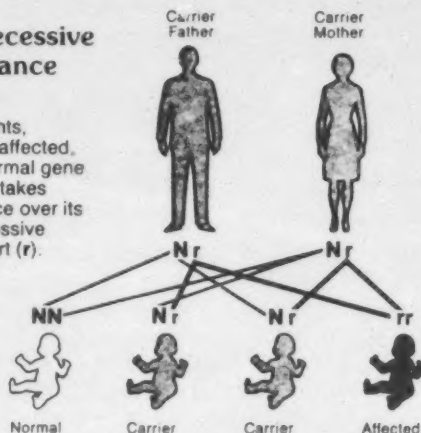
RECESSIVE INHERITANCE—Both parents of an affected child appear essentially normal, but by chance, both carry the same harmful gene although neither may be aware of it.

Unfortunately, the child who receives the defective gene from both parents may have a significant birth defect. Recessive inherited diseases tend to be severe and often cause death early in life, while dominant ones are often mild or late in appearing and rarely interfere with reproductive capacities.

When both parents are carriers of a harmful recessive trait, each of their children will run a 25 per cent (1 in 4) risk of manifesting that genetic disease. Each child will also have a 25 per cent chance of *not* inheriting the gene from either parent; and each has a 50/50 chance of receiving only a single defective gene and becoming a clinically normal carrier of the genetic trait like both parents. Should the carrier-child ultimately marry another carrier, he or she runs the same risk as his parents of transmitting the disease to the next generation. The chance of inheriting a recessive disorder is increased in a child whose parents are "blood" relations (consanguinous).

how Recessive inheritance works

Both parents, usually unaffected, carry a normal gene (N) which takes precedence over its faulty recessive counterpart (r).



The odds for each child are:

1. a 25% risk of inheriting a "double dose" of r genes which may cause a serious birth defect
2. a 25% chance of inheriting two Ns, thus being unaffected
3. a 50% chance of being a carrier as both parents are

Among 1,117 confirmed or suspected autosomal recessive disorders are:

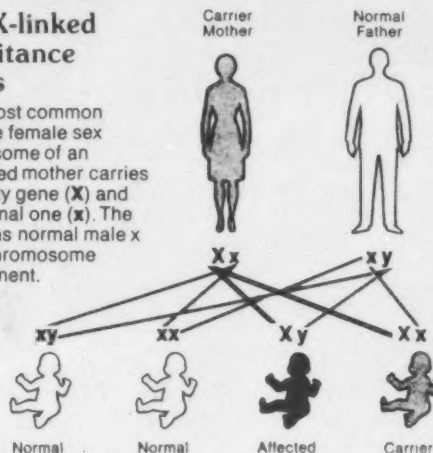
- cystic fibrosis—affects function of mucus and sweat glands
- galactosemia—inability to metabolize milk sugar
- phenylketonuria—essential liver enzyme deficiency
- sickle cell disease—blood disorder primarily affecting blacks
- thalassemia—blood disorders primarily affecting persons of Mediterranean ancestry
- Tay-Sachs disease—fatal brain damage primarily affecting infants of East European Jewish ancestry

X-LINKED INHERITANCE (sometimes called sex-linked)—Normal females have two X-chromosomes. Normal males have one X and one Y. Usually, a clinically normal mother carries a

faulty gene on one of her X-chromosomes. In such a case, each son has a 50/50 risk of inheriting that gene and manifesting the disorder. Each daughter has an equal chance of being a carrier like her mother, usually unaffected by the disease, but capable of transmitting it to her sons. No male to male transmission of X-linked disorders can occur. That is, a father cannot pass the disorder on to his son.

how X-linked inheritance works

In the most common form, the female sex chromosome of an unaffected mother carries one faulty gene (X) and one normal one (x). The father has normal male x and y chromosome complement.



The odds for each male child are 50/50:

1. 50% risk of inheriting the faulty X and the disorder
2. 50% chance of inheriting normal x and y chromosomes

For each female child, the odds are:

1. 50% risk of inheriting one faulty X, to be a carrier like mother
2. 50% chance of inheriting no faulty gene

Among 205 confirmed or suspected catalogued disorders transmitted by a gene or genes on the X-chromosome are:

- agammaglobulinemia—lack of immunity to infections
- color blindness—inability to distinguish certain colors
- hemophilia—defect in blood-clotting mechanisms

- muscular dystrophy (some forms)—*progressive wasting of muscles*
- spinal ataxia (some forms)—*spinal cord degeneration*

MULTIFACTORIAL INHERITANCE—A large group of genetic disorders result from the interaction of many genes with other genes or with environmental factors. The pattern of transmission in this group is less well defined, but it is known that the probability of recurrence is reasonably low. With one affected child in the family, chances of another having the same defect are five per cent or less.

The number of defects due to multifactorial inheritance is unknown. Some that are thought to be multifactorial are:

- cleft lip and/or palate
- clubfoot
- congenital dislocation of the hip
- spina bifida—*open spine*
- hydrocephalus (with spina bifida)—*water on the brain*
- pyloric stenosis—*narrowed or obstructed opening from stomach into small intestine*

a common mistake

When risks are stated in percentages or fractions, parents unfamiliar with genetic mechanisms often interpret them incorrectly.

For example, those with one child affected by a disorder due to recessive inheritance may think that a 25 per cent—or one-in-four—risk means that the next three offspring are not endangered. *This is not true.*

The risk of genetic disease is the same for every child of the same mother and father.

testing for carriers of genetic defects

A number of major inherited disorders occur with some frequency only because there is a relatively large proportion of carriers of potentially harmful genetic traits in the general population. While having the gene usually poses no health problem for a carrier, there is always the risk of serious genetic disease in any child of two carriers of the same harmful trait, or any son born to a mother carrying an X-linked defect.

Accurate carrier detection tests have been a major goal of genetic researchers for use in counseling individuals or couples at high risk for a given harmful trait. As more such tests are developed and refined, they may eventually be used as a vital part of general health examinations.

At present, carrier tests are available for a considerable number of potentially damaging genetic traits and more are being developed.

For example, simple blood tests can readily identify carriers of several serious blood disorders, including thalassemia (Cooley anemia) and sickle cell disease. (It is estimated that 10 per cent of blacks in the U.S. are carriers of the sickle cell gene.) Effective tests have been developed, too, for carriers of some inborn metabolic errors, such as Tay-Sachs disease, in which a defect or deficiency of a single enzyme interferes with a vital biochemical process. By measuring enzyme levels in blood or skin cells, carriers of a wide range of distinct errors of body chemistry can now be identified.

Practical and reliable carrier tests are still needed for several important genetic diseases such as cystic fibrosis, the most common genetic disease affecting the white population in the United States, and PKU (phenylketonuria), the inability to metabolize an amino acid, resulting in brain damage.

prenatal diagnosis of genetic defects

If there is a risk that a child will have a genetic disease, many parents are unwilling to undertake or complete a pregnancy.

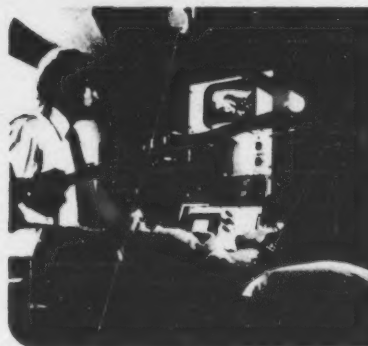
Relatively simple tests have made it possible to make a firm prediction about certain defects well before birth. One such procedure, called amniocentesis, is usually performed after the 14th week of pregnancy. It entails withdrawing a small amount of the amniotic fluid which surrounds the developing fetus in the uterus. Since the fluid contains fetal cells, it can yield invaluable information for genetic analysis. Amniocentesis is recommended only if a woman is at increased risk for the specific defects that can be diagnosed by this means. Indications are: advanced maternal age; previous child with a metabolic defect; the finding that both parents are carriers; and certain structural defects such as open spine.

Amniotic fluid must be obtained by needle through the mother's abdominal wall, into the cavity of the uterus or womb.

The usual procedure is to locate the placenta and position of the fetus with ultrasound equipment. This prevents injury to either when the needle is inserted into the amniotic sac. The use of sound waves (ultrasonography) to show specific physical outlines avoids the harmful aspects of X-ray. In experienced hands, the entire procedure carries very low risk for mother and fetus, and the discomfort is minimal. These are small problems in view of the peace of mind gained if prenatal diagnosis reassures parents that their unborn baby does not have the defect being tested for. Indeed, 97 per cent of the high-risk women using amniocentesis find that their fetus is free of the suspected defect.

If a defect should be identified, the physician knowing about it early in pregnancy is able, in some instances, to minimize damage through prompt action at or soon after birth. In any

event, parents are aided by firm information rather than statistical odds in deciding how to meet the problem. For some, it provides the opportunity of trying for a healthy infant without the risk of having an affected child.



Ultrasound picture (left) shows location of fetus and placenta to help guide safe entry of the needle used in amniocentesis as shown in diagram.

Prenatal testing by means of amniocentesis has added a new dimension to genetic counseling. But it has limitations. Genetic counselors wish a "normal" result could guarantee a healthy baby. But this is not possible, since only some birth defects are detectable by amniotic fluid analysis.

Without question, amniocentesis has proven useful in providing diagnostic information about potential defects resulting from chromosome error. Chromosome analysis of amniotic cells is also used to determine the sex of an unborn child, important when counseling parents on matters of X-linked inheritance.

Close to 100 inborn metabolic errors can be detected prenatally by analysis of enzyme levels in fetal cells. It is also possible to diagnose spina bifida (open spine) and anencephaly (absence of the brain) ... by testing the amniotic fluid for elevation of certain fetal proteins known as AFP (alpha fetoprotein). The diagnosis is backed up by ultrasound examination to show whether there are structural defects. It is hoped that prenatal diagnosis of genetic defects will soon reach the point where more common biochemical defects can be positively identified, and prenatal treatment begun.

how genetic counseling helps

When genetic studies are completed in a given family, the counselor, assisting health professional, or referring physician to whom results are reported, will not prescribe a particular course of action. Their role is to provide the family seeking help with a realistic view of the situation—the nature of the birth defect already manifested in a family member, the risk of recurrence and what a recurrence would mean in practical terms for all concerned—and to assist families through this difficult time in their lives.

If there are decisions to be made—about care of the child already affected, about having more children, about the ability of the family to cope with ongoing problems—the parents can make more informed choices with the facts in hand. This includes information on community resources which can help them and their children.

where to go for genetic counseling

A first step for a family needing genetic counseling is to recognize the need. This may come through personal concern about recurrence of a condition within the family, or may be suggested by a doctor. In modern medical practice the importance of genetic disorders is being increasingly recognized. As a result, more and more patients are being referred to specialized counseling services.

To meet the need new genetic counseling units have opened, or existing ones have been expanded, at many medical centers and teaching hospitals within the last few years. Some prefer to have patients and families referred by physicians or other health professionals, but many readily accept self-referred patients.

Some smaller localities far from major medical centers are served by "satellite" clinics. Specialists from a major counseling facility visit those communities regularly for consultation with

local physicians, hospitals and health departments, as well as with patients and their families.

8 J

Thus genetic counseling is becoming available to a growing number of people who can benefit from it.

ACTIVITY 12

FROM ONE GENERATION TO ANOTHER

FOCUS

Living things may vary greatly across many generations, but they are similar from one generation to the next.

OBJECTIVES

Students will have opportunities to

1. make a "creature" from common materials.
2. demonstrate their knowledge of dominant and recessive patterns of inheritance.
3. demonstrate how characteristics are determined by genes passed from parent to offspring.
4. expand their knowledge about how changes occur in organisms over many generations.
5. become aware of the continuity in living matter from generation to generation.

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. use the young "creature" they have created to demonstrate how patterns of inheritance occur in successive generations.
2. collect information about changes that have occurred in plants and animals over long time spans.

MATERIAL AND ADVANCE PREPARATION

The following materials will be needed by each team of students doing this activity:

Creature Card Sets A and B
brads (may use staples or tape instead)
scissors

Teachers should familiarize themselves with the ways the parts can be connected in Creature Card Sets A and B. A sample creature and its offspring may be useful to students who have difficulty visualizing how the parent creatures contribute genes to their young.

TEACHING CONSIDERATIONS

1. This activity is designed to allow students to express the concepts they have learned in the Generations section. Frequent teacher interaction is suggested with the different teams of students.

2. Divide the class into groups of three. Provide each group with Creature Card Set A. Ask the students to think about an imaginary creature. Have them think about ideas such as how it would move, obtain food, protect itself, and care for its young.

3. Ask students to observe the parts in Creature Card Set A. Tell the students they are to create two "creatures" using the parts from Set A. One creature will represent a female and the other will represent a male. Each creature has four characteristics which they may vary: head, body, legs, and tail. The characteristics will be either dominant or recessive. For example, "short ears" is dominant, SS. A creature with this characteristic would have two dominant genes for short ears. It might have either two dominant or two recessive genes for another characteristic. The combination not possible in the parents is one dominant and one recessive gene for a characteristic. This combination will be possible when students make the offspring "creatures." Remind students that each characteristic is determined by a separate pair of genes. They cannot mix the genes for different characteristics; they cannot cross parental creatures, for example, one of which has "short ears" and the other of which has "no eyebrows." It is a good idea to make "teacher creatures" to help clarify this problem and to demonstrate what you want done.

4. Have students cut out the parts from Creature Card Set A and make their own creatures. The individual parts should be fastened together using brads or staples. A chart is provided in the student materials to assist in recording information about the makeup of each organism.

5. When the parent creatures are made, have students show their organisms to the class. Let students describe which of the characteristics are dominant and which are recessive. Replace the extra parts that were not used in Card Set A. Take apart the parent creatures and put the parts in Card Set A.

6. Give each team of students Creature Card Set B. Ask the students to observe the parts. There are dominant, recessive, and dominant-recessive combination genes represented. These characteristics will be used to make the offspring.

7. Ask students to cut apart Creature Card Set B. Tell the students to create a "young creature" that could come from their parent creatures. The charts under student direction 4 will help students remember the gene combinations they chose for their parent creatures. Ask students to record information about their young creatures in the chart provided under direction 6.

8. Have students show their young creatures to the rest of the class. Encourage discussion about the similarities and differences between the young creatures and their parents. Ask students which characteristics contain hidden recessive genes. Allow time for extensive class discussion. Have students return their creature parts to Set B when all the young creatures have been discussed.

GUIDE TO CLASS DISCUSSION

Student answers to the Questions for Discussion I will vary. The questions are designed to provide stimulation for thought about how characteristics are

transmitted from parents to offspring. Students are asked to compare similarities and differences in their parent creatures and the offspring. Students are asked to account for change in organisms which occurs from generation to generation. Abstract concepts are often difficult for adolescent students. The point has been made if students understand that change occurs and that genes have a part in this change. The idea of continuity from generation to generation may only be vaguely understood, yet this will form a basis for later activities in the student's academic career.

The Questions for Discussion II are designed to provide more stimulation for discussion about continuity from generation to generation. The narrative and pictures in the reading "Changing Generations" should provide information which can facilitate student discussion. Allow ample time for student discussions. Do not expect "correct answers." Allow students to explore different possibilities as they consider how organisms have changed. The process of thinking about these ideas may often be of as much value to students as achieving "correct answers."

GOING FURTHER

Students who are motivated to use their young creatures to create another generation may benefit from a discussion about how genes combine in a random manner. Special attention will need to be given to the concepts of dominant and recessive. Teacher assistance may be needed for this part of the activity.

Pictures of different generations of plants and animals could stimulate discussions about change and how it occurs, as well as how similar recent living things are to those that have lived in the past. The theme of continuity can be stressed in these discussions. The Going Further activity allows students to create an additional generation using their "young creatures" as parent creatures. Help students keep close track of the dominant and recessive genes in these matings. Students should notice--or you should point out--that some of the characteristics that were "lost" (not expressed) in their first "young creatures" have reemerged in the next generations. This demonstrates the important concept that a recessive characteristic can be carried through many generations undetected, only to reemerge if mating occurs with an individual carrying the same recessive gene.

SELF QUIZ KEY

Allow variation in student answers to question 1. A general idea of genes transmitting material from parents to offspring and that material being related to change as well as continuity should be looked for in student answers.

NEW WORDS

populations
extinct

ACTIVITY 13

VARIETY IN LIVING THINGS

FOCUS

There is variation among the plants and animals on Earth. Some of this variation is due to environmental differences and some to genetic factors. These interact in individuals.

OBJECTIVES

Students will have opportunities to

1. think about different types of environments in which organisms live.
2. think about different kinds of organisms.
3. compare the similarities and differences in organisms.
4. compare chromosomal and other genetic similarities and differences in organisms.

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. examine variation within a group of similar organisms.
2. examine variation that exists between different groups.
3. examine the interaction between genetic and environmental sources of variation.

MATERIAL AND ADVANCE PREPARATION

Ten Living Things Card Sets and ten Chromosomes of Living Things Card Sets have been provided. Divide your class into ten teams to work with these cards.

You will need to cut apart the pictures in the Living Things Card Set before using them.

Review, if necessary, different types of ecosystems with students. Collect pictures of different examples. Discuss flora and fauna found in different areas. Pictures from magazines, books, or filmstrips may be used to assist students as they relate living organisms to special environments.

TEACHING CONSIDERATIONS

NOTE: This may be a two day activity.

1. Students are asked to examine pictures of several environments and organisms as a means of introducing the concept of variation. Comparing similarities and differences of organisms and the environments in which they live will assist in providing a contextual meaning for this term. Additional class discussion may be needed to further develop this idea.

2. The Living Things Card Set is designed to be used in a sorting exercise in which students place similar organisms into groups. This provides a concrete experience with variation between similar organisms and variation between organisms from different groups. Class discussion should be encouraged to get students to provide examples of variation from their own environment.

3. The Chromosomes of Living Things Card Set is intended to introduce students to the concept of a genetic basis for variation in organisms.

KEY TO QUESTIONS IN DIRECTIONS

Part I

1 & 2. Answers may vary. Examples may include:

Desert--snakes, Gila monster, horned toad, insects, cactus, small shrubs, and trees. These organisms may be specially suited for this environment by small leaves; thick, waxy leaves; deep root systems, ability to conserve water, sleeping during the heat of day, etc.

Alpine--small rodents, small plants, etc. Adaptations include sleeping during the cold part of the year, short growing season, etc.

3. The animals are alike in that they all breathe air, have legs, have protective covering, have eyes, etc.

They are different in that they are different sizes, have different types of body covering, eat different foods, move on different types of legs and feet, etc.

Variety is caused by genetic difference and by different responses to an environment.

4. The horses are alike in that they are all from the same species. They are different in their size, coloring, size and type of feet, etc.

Part II

Organisms will be grouped differently by different students. Encourage students to group by characteristics they observe.

Chromosomes are different between individuals. However organisms from the same species will have more similar chromosomes than organisms from different species.

Male and female have different sex chromosomes.

Students may need assistance with naming characteristics that are related to a particular gene. Lack of genetic knowledge makes it very difficult to determine exactly which gene(s) control all characteristics. Examples of characteristics determined by single genes are cystic fibrosis, hemophilia, and mid-digital hairy fingers.

GUIDE TO CLASS DISCUSSION

Part I of this activity seeks to help students recognize that there are many types of variation among living things and to consider the sources of this variation. Students are asked to identify different types of environmental habitats and the organisms adapted to them. (For instance, the desert is populated by such organisms as camels and cactus.) Students are also asked to consider obvious as well as subtle differences between species and among members of the same or closely related species. The questions encourage the students to consider the interaction between organisms and their environment.

Part II of this activity is intended to facilitate student discussion of the basis for gene-environment interactions in producing variation. Students are encouraged to consider which factors are biologically relevant in categorizing the observed variations.

The discussion questions are designed to expand student concepts of variation. More than superficial responses should be sought.

KEY TO CLASS DISCUSSION QUESTIONS

1. Student answers may vary. Do not expect sophisticated answers to this question. A vague awareness that environmental variation and variation in living things may somehow be tied together is probably the level at which many adolescent students will think about this question. Students should recognize that organisms seem to be adapted to their environment and that these adaptations can be passed on to later generations.

2. Yes. Chromosomes contain the genetic information of the organism. Different chromosomes may have both different amounts and different types of genetic messages.

3. Answers may vary. Encourage consideration of subtle differences as well as genetic information in categorizing organisms.

GOING FURTHER

Students are asked to examine variation in organisms in the school or home environment. Many genetic differences between individuals and between families may be identified by the students. Teacher assistance may be required to point out group similarities and to facilitate group discussion of differences and their implications for the function of groups and individuals.

Examples of human conditions due to chromosomal differences include Down syndrome, Turner syndrome, and Klinefelter syndrome. Information for reports on these conditions can be sought from libraries, medical personnel and facilities, special education programs, or private groups such as the the March of Dimes Birth Defects Foundation. Since individuals with these conditions are not rare, it is important to encourage sensitivity to the needs and feelings of affected persons and families in discussions of these topics.

Chromosomes from human and non-human primates have many apparent similarities. These have been interpreted as suggesting specific biological relationships. Interested students may wish to examine similarities and differences and speculate on the implications.

Differences in the frequency of certain forms of genes characterize different racial and ethnic groups of humans. However, all races and groups have the same number and types of chromosomes. Sex chromosomal differences between men and women have been previously pointed out in Activity 8.

SELF QUIZ KEY

1 & 2. Answers will vary but should correspond to a previous section in this activity. Student answers may contain examples found in this activity or in their own experiences. The answers to these two questions should provide a key as to whether students can distinguish variation within a similar group from variation among differing groups. For example, variation within a similar group might concentrate on differences in horses while variation among differing groups might concentrate on differences found in species such as mammals, birds, reptiles, etc.

ACTIVITY 14

I AM ME AND YOU ARE YOU

FOCUS

Students develop an understanding of the normal variation in human characteristics and an appreciation for where they fit in that range of variability.

OBJECTIVES

Students will have opportunities to

1. observe, measure, and record data for five personal characteristics.
2. construct histograms representing the compilation of classroom data for those traits.
3. determine where they "fit" in relation to the rest of the class.

ADDITIONAL OPPORTUNITIES

Students also will have opportunities to

1. consider the types of human characteristics that are and are not subject to change over time.
2. consider the types of characteristics that can be changed by personal intervention.

TEACHING CONSIDERATIONS

1. The characteristics used in this activity have been chosen to minimize negative connotations. The emphasis should be on the range of diversity rather than on the extremes of variation. Many genetic factors interact in each person, and all contribute to our individual variability. Some genetically-determined differences are more obvious than others.

2. The ranges represent normal variation as determined from data on the growth and development of students at this age level.

3. Except for sex, the traits used can be said to result from an interaction of genotype and environment. One of the traits--pulse rate--is more amenable to change by the individual, whereas the biologic component of some of the other traits is so strong as to make them immutable.

4. Help students to realize that variation also exists in the population at large. That is demonstrated by question #8, in which students place themselves on the continuum of variability for each characteristic.

NOTE: The word "characteristic" has been used in place of "trait" as junior high age students tend to get trait and sickle cell trait confused when they are used together. Even though "characteristic" tends to be more cumbersome than the word "trait," we prefer it to help avoid this confusion.

GUIDE TO CLASS DISCUSSION

The discussion questions are designed to facilitate an analysis of data obtained in the classroom. Each class will collect different data, thus answers will vary. Encourage students to think about characteristics which can be changed by personal intervention and which characteristics cannot be changed. Discuss the influence of genes on those characteristics which cannot be changed. Allow students to express their ideas of variation in their own words. If they understand that people grow and change at different rates, the point has been made. Each student should recognize his or her own uniqueness.

GOING FURTHER

Students are encouraged to investigate the way sex is determined. They may need your help as they compare variation in other characteristics. A survey of the media's influence on attitudes toward desirable changes might be useful as students think about which characteristics can be changed.

Nutrition (an environmental factor) can have important implications for growth just as genetic factors do. Students should be encouraged to examine the effects of malnutrition and "over nutrition." There are limits to how much modification of genetic factors can occur.

SELF QUIZ KEY

1. False

NEW WORDS

bar graph

ACTIVITY 15

GENES AND SURROUNDINGS

FOCUS

Students develop an appreciation of the importance of genotype/environment interaction.

OBJECTIVES

Students will have opportunities to

1. view a sound/slide program on genotype/environment interaction.
2. respond to a series of questions concerning the effect of environment and lifestyle on the expression of one's genotype.

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. list the components of their environment that might have an effect on health.
2. discuss which aspects of their environment are amenable to change and which are not.
3. discuss how genetic differences may influence resistance or susceptibility to environmental factors.

MATERIALS AND ADVANCE PREPARATION

Genes and Surroundings slide/sound program
slide projector with carousel
cassette tape player

Previewing of this program is recommended before it is presented to your class. A transcript, including Discussion Questions, begins on page 61.

TEACHING CONSIDERATIONS

1. Because of previous exposure to genetics, students may equate genetics with birth defects or abnormality. This program is intended to demonstrate the importance of genetics in human variability and to demonstrate that one's genotype is important throughout life. Expression of one's genotype is sometimes amenable to modification through environmental or lifestyle changes.

2. The term environment is used very broadly in this program. It is intended to include the personal environment (e.g., diet, exercise), the family, school, and the environment at large. It is important to stress that there are psychosocial aspects as well as physical aspects to the environment.

GUIDE TO CLASS DISCUSSION

The discussion questions are designed to encourage students to think about the interaction of genes and environment. You should encourage discussion about the aspects of environment that can be changed in order to promote health.

KEY

1. Answers will vary. Student lists of their environment should include psychosocial aspects as well as physical aspects. Answers such as food, exercise, support from family or friends, as well as pollution, climate, and geography are examples of appropriate responses.

2. Answers will depend on responses given in number 1. A general idea that genetic material cannot be changed should be included. Environmental changes can be made in response to negative genotype-environment interactions.

3. No

4. Answers will vary. Allow class discussion so that a variety of views can be expressed.

5. Student discussion should provide a variety of solutions to this question. Do not give any "correct" answers. Allow students to form their own solutions. Encourage them to realize that what is right for one person may not be a desirable response to the problem for another person and that variation exists in the solutions that people find for problems.

GOING FURTHER

Suggestions are provided for students to investigate further how environment might affect their health. Community resources can be contacted as sources of health information. Family and school environments can be investigated as to their effect on student health. A discussion could then be held about the health hazards in their local community and possible solutions to local problems.

SELF QUIZ KEY

1. genes and environment
Environment can sometimes be changed; genes cannot.

NEW WORDS

diabetes
allergies
asthma
emphysema
susceptible
resistant
albinism
toxic
cancer
galactosemia

TAPESCRIPT: GENES AND SURROUNDINGS, SLIDE/SOUND PROGRAM

- Frame 1: We don't think about it very much, but there are certain things that make us all human beings. We have two arms and two legs; we stand upright, and we can speak.
- Frame 2: But as you look around you notice that there are many different kinds of people.
- Frame 3: Small people and tall people...
- Frame 4: people with dark skin and people with light skin...
- Frame 5: quiet people and talkative people.
- Frame 6: These differences and similarities are so obvious that we hardly pay any attention to them...
- Frame 7: but the genes that make us the same--or different--are very important. The way the genes combine helps to determine...
- Frame 8: the way a person looks...
- Frame 9: the things a person is able to do...
- Frame 10:
- Frame 11: whether a person is generally healthy, and many other things.
- Frame 12: In some ways, a person is like a bicycle.
- Frame 13: Most bicycles have the same parts...
- Frame 14: but if you don't take care of a bicycle, it won't work.
- Frame 15: People are somewhat the same way. We all have the same parts, more or less...
- Frame 16: but we must keep our bodies in working order.
- Frame 17: Some things cannot be controlled very easily. For example, we inherit many characteristics from our parents, and children cannot control which genes they receive.
- Frame 18: Some characteristics--such as sex and blood type--are determined entirely by genes. These characteristics cannot be changed.
- Frame 19: Most human characteristics, however, are caused by a large number of genes that act together with the environment. Environment includes where--and how--you live. It also includes what goes on inside you. What kinds of things in the environment can affect you?

- Frame 20: Each of us has a large number of genes that help determine our height and weight. But our height and weight are also determined to a large extent by many things in the environment.
- Frame 21: Our weight is affected by how much we eat, how nutritious the food is, and how much exercise and rest we get.
- Frame 22: So, while we can't control the genes we get from our parents, we can control some parts of the environment. The environment, in turn, determines how some of those genes affect us.
- Frame 23: In other words, the condition that we think of as "good health" and many other aspects of life represent a balance between the environment in which we live and the sum of our individual abilities to cope with that environment.
- Frame 24: Sometimes our environment places demands on our bodies that exceed our inborn genetic capabilities. Examples include exposures to infections, dietary deficiencies, injuries, and toxic substances.
- Frame 25: This results in poor health. Can you think of examples of how our natural abilities interact with the challenges from our environment? List some ways that these could get out of balance. What would be the effect of such disturbances?

STOP FOR DISCUSSION

1. What do we mean by the internal environment? Give some examples.

(Students typically think of the environment as rocks, trees, mountains, rivers, and such. This question asks them to consider the internal conditions under which the cells, tissues, and organs of their bodies work. Students should be able to make this distinction and cite examples such as the presence or absence in the body of drugs, alcohol, too much salt, and so on. They should also realize that the body self-adjusts in many ways. Under normal conditions, it keeps the amounts of water, sugar, and waste substances within healthy limits in the blood and in other body fluids.)

2. Use height as an example to explain how both genetic and environmental factors account for human characteristics.

(Students should be able to explain that genes set limits or constraints on how tall a person will become. But environmental factors, especially nutrition in the first years of life, can make a big difference on how much of that genetic potential is actually realized.)

3. In your own words, summarize the idea that good (or poor health) is the result of both genes and environment.

(Accept all responses. This question sets the stage for the next sequence of the sound/slide program and the subsequent discussion.)

- Frame 26: Fortunately, some conditions that are determined by genes and the environment can be controlled by changing the environment. Diabetes, for example, can be controlled...

- Frame 27: by eating a carefully selected diet...
- Frame 28: by using insulin and other medicines, or by a combination of diet and medicine. Carefully balancing these factors allows people with diabetes to live normally.
- Frame 29: The differences in our genetic makeup cause each of us to be unique. They also give us different abilities to cope with our environment. Some of us are more susceptible to the effects of our environment than others.
- Frame 30: Most of us get a tan when we spend time out of doors in the sunlight.
- Frame 31: However, if we are not careful we can get a sunburn.
- Frame 32: Some persons are born with a genetic inability to make normal amounts of the pigment that colors our skin and hair, and helps protect us from the burning rays of the sun.
- Frame 33: This condition, known as albinism, results in an unusual susceptibility to sunburn and other problems (such as eye problems) related to light. The environment of these persons can be modified to protect their skin and other tissues by using clothing, sunscreens, and dark glasses.
- Frame 34: Sunlight can have other effects on the body as well. Too much exposure over many years can cause skin cancer from repeated damage to our skin.
- Frame 35: Some people have genetic characteristics which make them much more susceptible to these effects. If their skin is not carefully protected, they develop skin cancers at a very young age. Fortunately, this condition is rare.
- Frame 36: Our genetic makeup also influences how we respond to factors such as pollution of our environment.
- Frame 37: Smoking tobacco is known to have many bad health effects on people. However, not everyone who smokes gets all of these problems. Why do you think this might be?

STOP FOR DISCUSSION

1. It is impossible to predict with certainty the effects of certain substances on every individual who comes in contact with that substance. For example, not every person who spends a lot of time in the sun develops skin cancer. Yet we know that spending a lot of time in the sun makes skin cancer more likely--that is, a greater health risk. How might we explain these individual differences?

(This may be a difficult distinction for some students to grasp. Students of this age sometimes still think in absolutes. Make sure they understand the question before you proceed. The notions of "risk factors" or "increased probabilities" are extremely important in making decisions about health. Use this question to help students develop the idea that an individual may be more or less susceptible to the effects of certain risky exposures because of his or her genetic make-up. Chance also plays a part.)

2. Although we know that not everyone who smokes gets emphysema or lung cancer, doctors and health experts recommend that no one should smoke. Why do you suppose they make this recommendation?

(Students should be able to see that, as long as those who are resistant remain unidentified, we cannot be sure who is "at risk" and who is not. The advice of experts is based on the notion of "why take unnecessary chances?" But there are other reasons that students may not identify readily and you may have to point out. Smoking greatly increases risks for other disorders including heart disease, complications of pregnancy, and many others. As far as we know right now, most (if not all) human beings are susceptible to these risks. Point out to students that every health habit we make has more than one effect.)

- Frame 38: Some people have a genetic variation which interferes with their lungs' ability to resist the irritating effects of tobacco and other toxic chemicals. If these people smoke, they are likely to develop a severe lung disease known as emphysema.
- Frame 39: Other people may have greater genetic susceptibility to the cancer-producing effects of tobacco. They would be more likely to develop lung cancer.
- Frame 40: How can we prevent this from happening? Part of the answer for these people is to avoid smoking. They should also avoid jobs that would expose them to other irritating chemicals in the air they breathe. Do you think people should be tested for these differences? What difference would this make?

STOP FOR DISCUSSION

1. Suppose we could test people to find out who is susceptible to the cancer-causing effects of cigarettes and who is not. Should we conduct such tests and tell people the results? Why or why not?

(Accept all reasonable responses that students can explain with some degree of logic.)

2. Imagine a different situation. Suppose the owner of a factory could test people to see who might be harmed by exposure to a chemical the factory makes and who would not. Suppose the owner only wanted to hire people who would not be harmed. Is that fair? Why or why not?

(Again, accept all responses and use probing questions to help students test the logic of their answers.)

- Frame 41: A lot of research is being done to determine which environments and life styles can cause problems in some people.
- Frame 42: Scientists and other health-care people are working to develop tests to identify people whose genes may make them likely to develop certain medical problems in certain environments.
- Frame 43: If that becomes possible, those people can avoid situations that may cause them medical problems. Since we cannot change our genes, many of us may have to change the way we live in order to remain healthy. Sometimes we must begin these changes very early in life.

- Frame 44: In some places, babies are checked for genetic differences in their body chemistry. There are many genetic conditions in which foods that we usually can eat could have dangerous effects.
- Frame 45: For instance, babies with a genetic disorder known as galactosemia (guh-lak-tuh-SEE-mee-uh), can suffer severe damage from the tiny amounts of a normal type of sugar found in milk! Milk needs to be removed from the diet of these children so that they can lead a normal life. This is another example of environmental change.
- Frame 46: Not all genetic factors reduce our ability to withstand environmental influences. Some genetic factors seem to increase our resistance as well. People with these characteristics may be better suited to survive where certain environmental hazards exist.
- Frame 47: Scientists are now trying to understand other interactions between genes and environment. And there are lots of questions they can't answer yet.
- Frame 48: But it is fairly certain that genes can combine with certain kinds of environments to cause many medical problems. Heart disease, cancer, and diabetes are examples of such problems. These are among the leading causes of death in the United States.
- Frame 49: It is also likely that certain genes combine with the environment to cause asthma and allergies.
- Frame 50: Researchers believe that each of us has some genes that would make us sick--in a particular kind of environment. The research being done now will help individuals learn more about the effects of genes and environment on their health.
- Frame 51: Because we all carry a number of genes that might cause us to become sick in certain situations, it is important that we know about our personal and family health. Part of being responsible for your own health is knowing about your own body and about your family's health history.
- Frame 52: Knowing your family's health history can help you make decisions about what would be harmful to you and what kinds of environments and activities to avoid.
- Frame 53: It also can help you decide which kinds of environments and activities will promote and maintain your good health.
- Frame 54: There are many things in the environment that individuals cannot control.
- Frame 55: But we have a responsibility as citizens to make sure that our environment is as healthy as possible...
- Frame 56: so that all of us have the best chance possible to keep our bodies in good working order.

STOP FOR DISCUSSION

1. If other members of your family have a particular health problem, are you likely to develop that health problem some day, too?

(Students' answers should provide evidence that they understand the interaction of genetics with environment. The best answer is "maybe yes, maybe no" or "it depends." Encourage the use of concrete examples as illustrations.)

2. Give some examples of ways in which knowing your family history might help you make better health decisions.

(Student responses will vary.)

3. What are some of the health-related decisions that people your age have to make? How can you be sure you are making wise choices?

(Student responses will vary, but may include discussion of decisions about nutrition, smoking, drinking, exercise, sleep, sexual activity, drugs, and others. Responses to the second question will also vary, but may include ideas like getting all the facts, asking opinions from experts or experienced people you trust, learning from your own mistakes or the mistakes of others, keeping an open mind, asking questions, and so on.)

ACTIVITY 16

DECISIONS, DECISIONS

FOCUS

Students investigate the decision-making process and recognize the highly individual nature of most choices.

OBJECTIVES

Students will have opportunities to

1. identify several choices for a given situation.
2. analyze factors considered when making a decision.
3. determine what a "best" or "better" decision is.
4. recognize that each person is unique and has unique decisions to make.
5. realize that what "everybody else" does may not be best for the individual.

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. analyze personal decision making processes.
2. identify personal health decisions inherent in choosing a lifestyle.

MATERIALS AND ADVANCE PREPARATION

In this activity the decision problems should be read prior to their presentation to your class. Summary questions are provided in the teachers guide under Guide to Class Discussion. These should be reviewed before class discussion.

TEACHING CONSIDERATIONS

1. Divide the students into groups of 3-4. Have them read the Decision Problems and discuss the situations. Encourage them to consider all possible choices (even the ones they may consider bad).

2. These four examples were selected because they all involve kids learning to live with their limitations. All four of the issues (diabetes, club feet, scoliosis, and asthma) have a strong genetic component. These kids are learning to modify their behavior and their environment because they have to. There are many situations where health-related lifestyle choices are not imposed by existing health problems but where modification may still be appropriate. Examples of this are not smoking, exercise, maintaining appropriate body weight, eating a balanced diet, avoiding junk foods, etc. The students should be aware that decisions they make now can have long-term effects.

3. After students have shared their answers to the discussion questions with the class, lead the students into further discussion by asking the summary questions found in the following section.

GUIDE TO CLASS DISCUSSION

1. When the students have completed all four of the problems, compile their decisions. For each problem have the groups report all possible choices. Have each group indicate the choice they identified as being "best" and why they chose that particular one.

2. Questions that can be used to summarize the class discussion about decision making are as follows;

1. What types of things influence people when they make decisions?
2. Why do people sometimes make decisions that aren't necessarily the best ones?
3. What other situations can you think of where decision making is important?
4. How do people make decisions differently? Give an example of your answer.

Provide enough time for class discussion to allow expression of varying ideas. Exploration of all ideas should be encouraged to enable students to grasp the complexity of decision making. Class discussion should provide practice in analyzing different factors when making a decision.

GOING FURTHER

This section of the activity allows students to express privately decisions they have made. Students may share these decisions if they desire; however, care should be taken to be sensitive to students who desire confidentiality in these answers.

Question number two encourages students to consider choices that influence lifestyles. This allows students to identify the processes they use in making everyday decisions. Students can obtain practice in using their decision-making process. They also can recognize the individual nature of choices. A sample worksheet is included if students need assistance in designing a worksheet.

SELF-CHECK KEY

Allow variation in student answers. A concept to look for in student answers is that variation does exist in decisions that people make around different issues. Their realization that decision making is an individual process and that different things influence people as they make decisions is most important to this activity.

NEW WORDS

decision
asthma
clubfoot
diabetes
scoliosis

SAMPLE WORKSHEET: GOOD HEALTH ACTIVITIES

A. Dietary Choices

Good food choices:

1. vegetables
2. lean meat
3. milk
4. fruits
5. etc.

Poor food choices:

1. pop
2. candy bars
3. fats
4. too much of anything
5. etc.

B. Exercise and Health

(Five) healthful forms of exercise:

1. bicycling
2. swimming
3. hiking
4. basketball
5. etc.

What not to do:

1. sit and watch T.V.
2. lie by the pool all afternoon
3. etc.

C. Sleep

How much should I have? _____ hours/night

What happens when I don't sleep enough? _____

D. Other Health Choices

<u>Activity</u>	<u>Desirable</u>	<u>Undesirable</u>
1. regular checkup	X	
2. smoking		X
3. alcohol		X
4. brushing teeth	X	
5. regular bathing	X	
6. getting help for emotional problems	X	
7. letting anger build up inside me		X
8. etc.		

ACTIVITY 17

CHANGE IN LIVING THINGS

FOCUS

Students use timelines to compare the developmental rates of different organisms.

OBJECTIVES

Students will have opportunities to

1. examine a timeline for human growth and development.
2. construct timelines for five different organisms.
3. compare rates of growth and development as shown on the timelines.
4. answer a series of questions concerning growth and change.
5. complete a chart on stages of growth and the development of body parts.

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. collect data on other organisms and construct additional timelines.
2. consider how groups of organisms change over long periods of time.
3. complete a short reading on genes that are switched on and off.

MATERIALS AND ADVANCE PREPARATION

A colored pencil and ruler will be needed by each student performing this activity.

Read over the activity to become familiar with the timelines of the various organisms. You may want to bring to class data about other organisms.

TEACHING CONSIDERATIONS

1. This is intended as a basic, introductory activity about variability through time. The frame of reference, however, is not variation or time in an evolutionary sense. Rather, the emphasis is on how individual organisms change over their lifetimes. Going Further suggestions can be used to explore the notion of species change, or evolution.

2. Emphasize that there is variation in growth and development among different types of organisms (e.g., whales and pea plants) and between members of the same species (e.g., the tremendous variability among the students in a junior high class).

3. While it is a difficult notion, one would hope that students will come away from this activity with a sense that growth and development are not random and haphazard, and that they are, instead, under some kind of control. It is important to emphasize that genetics is not something that is concerned solely with prenatal development and/or birth defects, but that most of one's bodily functions, including growth and aging, are under genetic control. The Genes and Growth section is intended to address that notion more directly. Students should come to realize that the genes are responsible for the growth, development, and ongoing operation of all body organs and systems. The reading on genes and hemoglobin is intended to demonstrate the fact that certain genes are "turned off" after their particular task is completed and that other genes are "turned on" as needed. The incomplete state of knowledge about gene regulation is also an important point. Activity 25 (Stomach Aches and Milk) on lactose intolerance is another example of certain genes switching off after a certain period of time.

GUIDE TO CLASS DISCUSSION

The discussion questions are designed to be used with the completed timelines.

KEY TO DISCUSSION QUESTIONS

1. Organisms pass through similar stages but at different rates.
2. Different organisms go through stages at different rates or ages.
3. Answers will vary. Most answers will probably be adolescence.
4. No. Examples may be drawn from their own experiences or from observations made in the classroom.
5. No. Mice will pass through the same stages but there will be some variation in the age at which they pass through these stages. However, the variation will be less than if comparisons were made between mice and another type of animal.

SELF QUIZ KEY

1. True
2. False
3. True
4. Have students turn in and explain their timelines for the swine and sheep.

GOING FURTHER

Students may extend this activity by using resources in the school or public library to gather information about the growth rate of other organisms. Comparisons could be made between changes that can be observed in currently living organisms and the changes individual species have undergone throughout their histories on earth. For example, variation exists in present-day horses. There is also a great amount of variation between present-day horses and their ancestors.

NEW WORDS

range
timeline

sexual maturity
hemoglobin

geneticist

ACTIVITY 18

GROWTH AND CHANGE

FOCUS

Students develop an understanding of the orderly progression in human growth and development which varies in rate and extent among individuals.

OBJECTIVES

Students will have opportunities to

1. sequence photographs showing stages of human growth and development.
2. compare and contrast patterns of human growth and development.
3. identify stages in their own development.

ADDITIONAL OPPORTUNITIES

Students also will have opportunities to

1. investigate changes in health needs throughout development.
2. interview an elderly person for personal remembrances of change during development.
3. chart stages of development in a small child.

MATERIALS AND ADVANCE PREPARATION

Special materials will not be needed for this activity.

A good reference for you to have available is: Smith, D. W. and E. L. Bierman, The Biologic Ages of Man, W. B. Saunders Co., Philadelphia, 1973 (paperback).

TEACHING CONSIDERATIONS

1. This activity is intended to allow students to examine variations in personal development through time. It should not become a time of embarrassment or ridicule for students whose development seems to be "ahead" or "behind" that of others.

2. Key to Stages of Human Development Chart: Growth and Change Worksheet

Stages in One's Life

1. G
2. B
3. F
4. A
5. E
6. C
7. H
8. D

Age of Person in Photo

- prenatal (embryonic & fetal periods)
newborn
2 years (infancy)
4 years (early childhood)
8 years (later childhood)
14 years (adolescence)
25 years (adulthood)
75 years (old age)

3. This activity may take more than one time period.

GUIDE TO CLASS DISCUSSION

When discussing student results on the chart, focus on the criteria they used to sequence the photos. Introduce the idea that the subject pictured changed physically as well as many other ways. Have students speculate on how the subject's interests and needs might have changed through time.

KEY TO QUESTIONS FOR DISCUSSION

Part I

1. Answers will vary. Differences may include height, weight, and clothing styles. Similarities may include sex and some clothing styles.
2. While no two people are exactly alike, all people pass through similar stages from birth to old age.
- 3 & 4. Even though all people pass through similar stages during a lifetime, individual variations make each stage unique and different from another person's life.
- 5 & 6. To a certain extent, one can control one's environment. Thus, a person is able to control, to a limited extent, her or his development.
7. People grow and develop faster at certain stages. However, within these stages, people do not grow at the same rate. Both environment and hereditary material influences how one develops. This rate is different for each individual.

Part II

All people go through a similar series of growth stages. However, everyone does not go through the same stages at exactly the same time or age. We learn to recognize clues from a person's appearance that give us an idea of their growth stage. For example, young people tend to have round faces, older people have longer faces and may have lines or wrinkles. Our genetic inheritance and environment influence how we look. They also affect how well other people can tell what growth stage we are in. We have no control over our genetic inheritance, but we do have control over our environment. Therefore, we can affect some of the things that affect how we grow.

GOING FURTHER

Students are encouraged to investigate changes in health needs by library research, personal interviews, and by examining their own developmental history. An example is provided to illustrate the chart students are asked to construct in Suggestion 3.

Suggestions for biographical readings can be found in the accompanying supplement "ONCE I WAS A TEENAGER TOO."

A laboratory activity including observation of the development of a chick embryo (or other similar activity) may be of great interest to some students. Instructions for such an activity are found in most biology books.

SELF QUIZ KEY

1. T
2. T

NEW WORDS

development
maturation
predictable
uterus
placenta
conception
embryo
biologic
phase
prenatal
duplicate
fetus

ONCE I WAS A TEENAGER TOO*

Famous People You Can Meet in This Activity:

Rachel Carson. Biologist and writer who alerted the world to the dangers of pesticides--from Sea and Earth: The Life of Rachel Carson by Philip Sterling.

Cesar Chavez. Union organizer for the United Farmworkers--from Mighty Hard Road: The Story of Cesar Chavez by Terzian and Cramer.

Shirley Chisholm. Dynamic Congresswoman from New York--from Unbought and Unbossed by Shirley Chisholm.

Thomas Edison. Inventor of over 1,000 different inventions--from Thomas Alva Edison by Mervyn D. Kaufman.

Howard Hughes. Multi-millionaire man of mystery--from Howard Hughes by John Keats.

Joe Namath. Quarterback of the New York Jets--from The Joe Namath Story by Larry Bortstein.

O. J. Simpson. Running back of the Buffalo Bills--from O. J. Simpson by Jim Baker.

Laura Ingalls Wilder. American pioneer of the 1870's--from By the Shores of Silver Lake by Laura Ingalls Wilder.

* Adapted from BSCS, Where Do I Fit?, Human Sciences Program, Experimental Edition, 1974.

ACTIVITY 19

GROWING UP, GROWING OLDER

FOCUS

Students construct growth curves to compare the developmental rates of different adolescents.

OBJECTIVES

Students will have opportunities to

1. observe drawings of different adolescents and compare their different rates of growth.
2. construct growth curves of the growth rate of six different adolescents.
3. answer questions about patterns of growth in adolescents.
4. construct additional growth curves and compare average heights for adolescents.

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. write a story describing how a person might feel as he or she grows up.
2. interview an adult to learn how he or she felt about growing up.
3. predict their adult height.

MATERIALS AND ADVANCE PREPARATION

colored pencils
ruler

You should read the activity and be sure to understand how to use the growth curves.

TEACHING CONSIDERATIONS

1. The emphasis of this activity is on how individual humans grow during adolescence. The body of the activity discusses changes in specific people. Going Further suggestions can be used to explore average rates of change in adolescents and their attitudes.
2. Emphasize that there is variation in growth and development between individuals and that a person may be normal and yet not be average; in fact there are very few exactly "average" people.
3. Be sensitive to the fact that different degrees of sexual maturation and different heights may create anxieties among some class members. They need reassurance of their normality and acceptability.

4. Students may need to remove the graph pages from the book. This will allow students to place information charts next to their graphs. This also will be of help when students are answering discussion questions.

KEY TO DISCUSSION QUESTIONS

These discussion questions are designed to be used with the completed bar graphs.

Part I

1. Maria, Frank, Joe, Peggy
2. Frank was taller than Joe at age 16. However, when both boys were 17, Joe had grown taller than Frank.
3. Students may have difficulty with this concept. You might allow students to measure themselves and take the average of their own heights in order to provide a concrete example. Average is determined by adding together the individual heights and then dividing by the number of students. No height represented was exactly average. (NOTE: Stress the idea that one does not have to be "average" to be normal.)

Part II

1. 12 years
2. slower
3. Girls peak at an earlier age. Girls tend to grow in height at an earlier age in adolescence than do boys. It is normal for boys to begin their rapid growth at a later age than do most girls; however, most boys grow taller than most girls.

GOING FURTHER

Students are provided an opportunity to explore how different people feel about growing up by writing a story about a person or by interviewing adults. Further opportunities for class discussion about "average" and "normal" provide extension of concepts presented in the body of the activity.

SELF QUIZ KEY

1. girls
2. false

NEW WORDS

average
normal
adolescent
bar graph
height velocity

ACTIVITY 20

DIFFERENT KINDS OF GROWTH

FOCUS

People go through different kinds of changes as they grow. Growing may mean changes in size, age, number, or form.

OBJECTIVES

Students will have opportunities to

1. read about different ways of growing in a "Growing" comic book.
2. put in order a variety of pictures to represent how a girl grew and changed.
3. compile a list of changes they observe in pictures of a girl's childhood and young adulthood.

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. record changes they observe in their environment.
2. interview people from three different age groups and compare how different people change over time.
3. observe change in organic substances.
4. observe change in people's pictures, animals.
5. discuss and think about aging.

MATERIALS AND ADVANCE PREPARATION

scissors, 1 pair for every 1-2 students
a set of Growing Pictures for each student or group of students doing this activity
try to obtain yearbooks of successive years.
specimen (preserved or plastic embedded) stages of life of some metamorphic animal
examples of fungus growing on something organic

TEACHING CONSIDERATIONS

1. Different ideas about growing are presented in the "Growing" comic book. Students may view growing only as getting older or bigger. This book shows that growing also may mean increasing in number as well as changing in shape or form. Emphasize, as in Activity 17, that growth is not haphazard. It is under genetic control and can be influenced by environmental variables. Students are shown examples of an organism going through more than one type of growth at the same time. It may also change form. Examples of growth in nonliving things from the environment (such as growth in buildings) are provided. A class discussion of

different types of growth is suggested before proceeding to the rest of the activity.

2. Students are asked to order the Growing Pictures from youngest to oldest. The letters on the back of the pictures can be used to indicate the correct order. (Z, Y, X, W, V, U, T, S). Using the photos, a comparison of different types of changes can be made. Students might notice changes in clothing styles, physical size, appearance of body features, or activities of the girl as she grew older. As students view the pictures, extensive class discussion of growth and change should be encouraged. Questions have been provided with the pictures to facilitate these discussions. Answers will vary; however, the idea that change occurs as one grows up will probably be found in most of the comments.

KEY TO QUESTIONS FOR DISCUSSION

1. Alike: face shape alike, eyes alike, maybe both have same hair color or texture

Different: size, age, weight, height, sex

2. Alike: similar facial features; obviously from same family, mouth shape the same

Different: age, height, size, weight, hair color

- 3-4. Answers will vary. Accept any answer which indicates that students are aware that both people grew and changed.

5. Answers will vary and may include genes, good nutrition, lack of serious illness, healthy environment, etc.

GOING FURTHER

Opportunities are provided for students to observe changes in living and non-living things in their environment. People of different age groups may be interviewed to learn how different people change over time. Both suggestions can be used as extensions of the concepts presented in the body of the activity.

Get yearbooks from school office of several successive years. Look for persons who are in at least 3 years' books; try to spot changes in them (both students and adults).

Discuss aging: visible change, attitude, health, needs, etc. Try to decide what detains or slows the aging process.

Ask of being healthy, getting sick, then healthy again or not regaining health represent expected changes. Emphasize that this too is change--sometimes caused by environment, genetics, habits, age, or accident--but it still is change.

SELF QUIZ KEY

1. size, older, increase in number (more), different (shape or form)
2. Answers will vary. Accept any answer that indicates that students are thinking about the different ways they are growing and changing.

NEW WORDS

none

ACTIVITY 21

WHAT IS AN ENVIRONMENT?

FOCUS

Many different things make up the environments of human beings.

OBJECTIVES

Students will have opportunities to

1. identify living and nonliving parts of their classroom environment.
2. identify living and nonliving parts of their home environment.
3. identify urban and rural environments.
4. identify parts of their internal environment.
5. answer questions about their interactions with their own environment.

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. try to picture environments being described from a reading.
2. identify different types of environments by making collages.
3. investigate different types of environments and the living organisms found in them.
4. create and describe an environment for a "something" (living or nonliving) in a container no larger than 30 cm x 30 cm.

MATERIALS AND ADVANCE PREPARATION

Choose one or two short sections from a book or story that vividly describes several varied environments. (The reading on Loretta Lynn may be useful here again.)

Have magazines available to be cut up. The library may help.

TEACHING CONSIDERATIONS

1. This activity is designed to provide many different concrete experiences of the concept "environment." A variety of environments--rural, urban, and internal--is presented. Students are provided several opportunities to identify both living and nonliving parts of various environments. While this activity may move fairly quickly and seem simple to many students, it is designed to provide a basis for later discussions of environmental/genetic interactions. Therefore, it is suggested that you devote ample time to discussion and exploration of this concept.

2. Discussions on world environmental problems and how they affect organisms living in these environments could be very effective.

KEY TO QUESTIONS FOR DISCUSSION

1. Answers will vary; however, the student lists will probably stress different aspects of the environments. Ask students to tell why they chose the environmental characteristics that they described.
2. As human beings, we are part of our environments. Ask students to describe how they affect their environment and how it, in turn, affects them. Allow variation in student answers. A discussion of this concept is of more importance than achieving a "correct" answer, since this abstract concept may be quite difficult for some students.
3. Examples may be drawn from this activity. Answers might include body parts such as blood, heart, nerves, skeletal system, body fluid, cells, skin, etc.
4. Yes. Any example of living or nonliving things will be sufficient.
- 5-6. Answers will vary. Everyone harms the environment in some way.

GOING FURTHER

This activity may be extended by asking students to collect pictures of various types of environments. A class discussion may center around the various types of environments and where they are located. Students may also identify different kinds of organisms found in the environments. A discussion of the interaction of environment and organisms can provide a basis for further activities.

Read sections from one or two stories that describe different types of environments. Have students describe the differences and possible effects on the main characters. For your convenience, two such story sections follow:

STORY # 1

Margaret Jones was excited. She had long waited for this day. She was going to college. She and her mother and sister had been busily preparing for this day for weeks. Clothes needed to be mended and pressed. Margaret's sister sewed her some new clothes. They made special shopping trips to a nearby town to purchase a few new items. Margaret would always remember her trip to Memphis to purchase a new, down-filled jacket. Margaret felt so lucky that she would have this beautiful new jacket to wear to her school's football games. Who would have thought that a girl that had grown up on a small farm in Arkansas could be so lucky.

But the day was here. It had finally arrived. Margaret was about to leave her home for the first time. She would be living away from her family and home where she had felt so protected. She would leave the animals and fields that she knew so well. All this would soon be traded for a room and roommate that would be new and strange. Her world would rapidly change from the slow-moving, familiar farm to a college town where people didn't rise in the morning with the sun. People in town lived on a different schedule than did Margaret's farm family. Margaret felt a tinge of excitement as she threw back the covers from her bed in the chilled room and rushed to slip into her warm clothes. She thought, "Today is the most exciting day of my life."

STORY # 2

Sasha looked out of the window of the bus as it rumbled along the busy city street. She was on her way to the library. Sasha's father had awakened her early and helped her prepare a quick breakfast. This was an important day. Sasha would begin helping the librarian. This was Sasha's first job. Sasha was

14 years old, and she had been waiting until she was old enough to get a job. Sasha had been shy about asking the librarian if she could help shelve books on weekends. But the librarian had been kind, and talking with him had been easier than Sasha had imagined it would be. Now Sasha was on her way. She daydreamed as she leaned her head against the bus window. "I can buy a new bedspread for my room, and I can get Mom the slippers she needs. I wonder if I will have earned enough money by the end of the first month to surprise her."

SELF QUIZ KEY

If students are aware that environment means "surroundings," the point has been made. Examples may come from this activity or from personal experience.

NEW WORD

collage

ACTIVITY 22

WHAT IS ADAPTATION?

FOCUS

The special ways living things fit into their environment are called adaptations.

OBJECTIVES

Students will have opportunities to

1. observe pictures of adaptations of various plants and animals to their environments.
2. compare a human hand and an ape hand and think about how well each is adapted for handling small objects.
3. investigate how well their own hands are adapted for performing manipulations of small objects.
4. create an imaginary organism and demonstrate how it is adapted to its environment.
5. answer questions about the meaning of "adaptation."

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. examine pictures of various plants and animals and discuss how the organisms are adapted to their environments.
2. examine a living plant or animal and discuss how it is adapted to its environment.

MATERIALS AND ADVANCE PREPARATION

Ask students to read directions for Part 2 ahead of time and bring "things" from home they'd like to use.

The following materials will be needed by each student or group of students performing this activity:

glue	rubber bands
string	paper clips
scissors	construction paper
pencil	toothpicks
paper	tempera paint (black, white, green)
stapler	tongue depressors
buttons	masking tape
wire	pipe cleaners

The materials will need to be collected and placed in a central location for students to use as they make their organisms. Other materials you have available may be added to the list above. You might find it useful to prepare a demonstration organism. Show sample adaptations such as food getting, protective devices, methods to care for young, or seed dispersal.

Refer to any Life Science text for pictures of adaptations.

TEACHING CONSIDERATIONS

1. This activity is designed to introduce students to the concept of adaptation. Students are asked to observe living organisms and to identify ways they have adapted to their environment. You may need to provide extensive direction to get students used to thinking about ways plants and animals "fit" their surroundings. Some adaptations may be so familiar to students that they will not immediately recognize them as ways of fitting the environment. You may need to point out the benefits of a duck's wide, webbed feet, a monkey's tail, a water lily's roots and leaves, or a human hand with its opposable thumb.

2. Many students enjoy trying to adjust to their environment without their special adaptations. For example, students may want to extend the part of the activity in which their fingers are taped. You might let them try performing some class activities without the benefit of their sight, keen hearing, or the use of one of their fingers. Students often enjoy identifying their own adaptations and trying to perform class activities without them. A lively class discussion may result from allowing students to extend this section of the activity.

3. When students have successfully identified adaptations in a variety of living organisms, they may create their own organism and give it special adaptations. The suggested materials can be used to make their imaginary organisms. Ask students to make two or more adaptations for their creature's environment. Tell students they will be expected to demonstrate how their creature fits its unique environment.

4. When students have finished making their organisms, let them demonstrate their creations. You might provide a space in the classroom where the organisms can be displayed. Other classes often enjoy seeing what adaptations have been designed. Class discussions can be sparked by ideas from other students.

GUIDE TO CLASS DISCUSSION

Key to Questions for Discussion

1. If students have the idea that organisms "fit" their environment, the point has been made.
2. 3. Look for ideas which include the use of the thumb in the human hand.
4. Answers will vary; however, the answers should correlate with the individual organisms created by the students.

GOING FURTHER

Students may look at pictures of various types of environments and the living things found in them. A discussion may be held which examines the adaptations and how they are useful. They might also enjoy observing a living plant or animal and trying to identify and describe the adaptations.

SELF-CHECK KEY

1. Answers will vary with individual creations. You might ask students to describe how the organism obtains food, gets shelter, reproduces, or cares for its young. Seed dispersal is an important characteristic to discuss in plants.

NEW WORDS

adaptation

adapted

ACTIVITY 23

TIME MACHINE

FOCUS

People adapt to their environments in different ways. This type of adaptation is different from biological adaptation.

OBJECTIVES

Students will have opportunities to

1. participate in a skit to show how a person is adapted to her or his environment.
2. compare how people in different times adapt to their environments.
3. answer discussion questions about ways people adapt to their environments.

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. investigate how American Indians have adapted to their environment and write a story about an imaginary Indian family.
2. investigate how different groups of people adapt to their present day environment.
3. compare biological change with environmental change.
4. examine the relationship between adaptation and survival.

MATERIALS AND ADVANCE PREPARATION

Role cards, costumes and props will be needed by each group of students participating in this activity. Advance preparation will entail collecting different costumes and props.

TEACHING CONSIDERATIONS

1. It is important in this activity to make the distinction between biologic (organic) adaptation and cultural adaptation, which is unique to humans. Biologic adaptation, which involves changes in the gene pool, is common to all organisms and proceeds slowly. Humans possess the ability, through the development of cooperation and culture, to alter the environment or to mediate its effects, e.g., by putting on warm clothing. We are not dependent, therefore, solely on biologic change for our response to changing environments. Contrasting the rate of biologic change with that of cultural change can provide interesting topics for discussion. Rapid industrial and technologic growth, for example, have changed the environment so quickly--often for the worse in terms of pollutants--that biologic change cannot keep pace. Many geneticists worry that we are exposing a fragile, slowly evolving gene pool to a rapidly growing number of

mutagens and carcinogens. There is not sufficient time for biologic adaptation to all of these substances. The effects of rapid environmental change induced by humans can be seen in the extinction of an increasing number of organisms.

2. Divide the class into groups of five. Give each team a set of role cards. One group will represent people from prehistoric times. Other groups will represent people from pioneer days, early 1900s, and modern times. Ask each group of students to read their role cards and assign the characters to their members. Give each team thirty minutes to make up a skit which depicts how people adapted to their environment during their time reference. Allow students to use the costumes and props you have provided. Be sure to remind students that they can only use costumes and props that would be available in the time they are representing.

3. Circulate among the groups to help students with their skits as needed. Some students may be shy about appearing before their peers. It might be helpful to them if you demonstrate some behaviors which would illustrate how people were adapted to the environment. Such behaviors might include building a fire to cook food in prehistoric time, building a wood fire in a cookstove for pioneer days, using gas or coal during the early 1900s, and using electricity in a microwave oven for modern times. Have the students present the skits in sequence beginning with prehistoric times and continuing until modern times. Students should be able to see how people have adapted differently to their environments. When all the skits have been performed, have students turn in their role cards and answer the Questions for Discussion.

GUIDE TO CLASS DISCUSSION

The discussion questions are designed to stimulate ideas about different ways people adapt to similar environments. The adaptations will often vary with the time in which people live. The answers to the questions will vary. Sample answers have been provided which would be acceptable.

KEY TO QUESTIONS FOR DISCUSSION

1. Prehistoric: Hunting or gathering; some food may be cooked.
Pioneer days: Hunt with guns; agriculture was important; food could not be frozen.
Early 1900s: Food could be canned and stored in ice boxes. Grocery stores also were available to provide food.
Modern times: Grocery stores are the primary source of food; refrigeration is widely available.
2. Prehistoric: Wood
Pioneer days: Wood stoves
Early 1900s: Coal, gas, some wood
Modern times: Gas, electricity
3. Prehistoric: Tools, food, clothing. These had to be collected or made.
Pioneer days: Barter was popular; currency was used; much was made at home.
Early 1900s: Currency was used; factories made items that could be sold.
Modern times: Currency; most items are factory-made.

Answers will vary. If the students have the idea that people adapted to their environments in the different times, the point has been made.

4. The environment has changed more over the last 500 years than has human appearance. Biologic change is slow, resulting from genes interacting with the environment. Humans using technology can change the environment very rapidly.
5. Plants and other animals change slowly in response to environmental changes. Humans also undergo biologic change, but that is very slow when compared to our ability to adapt by changing the environment.
6. In general, the environment will change more rapidly than the genes shared by organisms of the same type. Genetic changes (mutations), if they persist, take a very long time to reach significant frequency in the gene pool.

GOING FURTHER

Going Further suggestions are designed to guide students in exploring how people have adapted to different environments. They may look at how American Indians have adapted to their environment, as well as how modern groups of people are adapting to current environments. Newspapers, books, and magazines can provide information on these topics. It might also be useful to have students try to interview different people to see how they are adapting to their present environment.

SELF QUIZ KEY

- 1-3. Student answers will vary. The key idea to look for is an awareness of adaptations to different environments.

ACTIVITY 24

STOMACH ACHES AND MILK

FOCUS

The principle of adaptation is introduced using a reading on lactose intolerance.

OBJECTIVES

Students will have opportunities to

1. review the concept of chromosomes as containing hereditary information.
2. identify the units of information on a chromosome as genes.
3. correlate genes with control of a given characteristic.
4. compare lactose tolerance in babies and adults.
5. consider how babies are adapted to digest milk.

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. investigate what milk products have low amounts of lactose.
2. discuss the possible reasons for certain human populations retaining milk products in their diet.

MATERIALS AND ADVANCE PREPARATION

15-30 popbeads
paper clips (or other appropriate model)
Transparency set: overlay on genes (D) plus transparency AB

TEACHING CONSIDERATIONS

1. Part I of this activity is a teacher-directed introduction to the concept of genes.
 - a. Review the concept of chromosomes as "information on how to make a body."
 - b. Direct class discussion toward how much "information" the chromosomes must have in order to not only make a body but also keep it functioning and healthy.
 - c. Review the term gene as a unit of information.
 - d. Demonstrate the relationship of chromosomes and genes by using popbeads (or appropriate model), emphasizing
 - each chromosome is composed of thousands of genes (total number of genes is greater than 100,000).
 - the linear arrangement of genes.
 - that while located next to one another, most genes are thought to function independently.

- e. Utilize transparency overlay series to further illustrate the concept of a gene. A sample procedure is outlined below.
 - Project overlay transparencies AB (male). Ask students to identify individual chromosomes. Ask them to describe the chromosomes.
 - Overlay transparency D. Since chromosomes are paired, genes are also paired.
2. Allow students 10-15 minutes for reading, "Can You Drink Milk?"
 - a. Introduce the idea that the ability to digest the lactose in milk as an adult is controlled by a dominant gene.
 - b. Encourage discussion about the three families. Some of your students or someone in their family may have the problem. Ask. The ability to digest lactose as an adult is controlled by a dominant gene. This ability is represented in the pedigree by a dark color. Notice that the Changs do not have dominant genes for digesting milk. Neither they nor their children can digest milk. Mrs. Whitefeather does have a dominant gene. Therefore, she can pass this characteristic on to her children. The Whitefeather children who receive the dominant gene will be able to digest milk when they are adults. Both Mr. and Mrs. Smith have dominant genes for digesting milk. Their children also will be able to digest milk when they are adults.
 - c. Ask students to look at the figure on page 165. Some people (mostly those of Northern European descent) have at least one gene (L), which enables them to digest milk as adults.
 - d. Review the term dominant. Try to avoid use of the words "stronger" and "weaker" when doing so.
 - e. Point out that with dominant characteristics:
 - both males and females can express the characteristic.
 - if someone has the dominant gene they will express the characteristic.

BACKGROUND INFORMATION ON LACTOSE INTOLERANCE

Lactose in milk causes intestinal discomfort and diarrhea in many people who have lactose intolerance after the age of weaning. This intolerance is due to a decline in lactase activity (i.e., adult lactase deficiency). With few exceptions, in all mammals lactase activity declines after weaning. It is unique to humans to maintain lactase activity. The progression from lactose tolerance (i.e., absorption of lactose because of the presence of lactase enzyme) to lactose intolerance (i.e., malabsorption of lactose because of enzyme deficiency in adults) is a normal developmental process for a large segment of the world population. Populations with a high incidence of lactase deficiency are

Australian aboriginals	60-90%
Orientals (Chinese, Japanese, Filipino, and Korean)	95-100%
Africans (different groups)	44-90%
American blacks	70-77%
European-Caucasian	20%

The ability to make lactase as adults is predominant among individuals of Northern European ancestry. It has been postulated that the maintenance of lactase activity became common in populations that developed dairy-related occupations several thousand years ago.

A resource for classroom use is the child-oriented book titled You and PKU by Margaret Taylor and Virginia Schuett. Copies may be obtained from

Virginia Schuett
Discipline Chief
Nutrition Section, Diagnostic and Treatment Unit
Waisman Center on Mental Retardation & Human Development
1500 Highland Avenue
Madison, Wisconsin 53706

GUIDE TO CLASS DISCUSSION

The questions for discussion have been designed to stimulate ideas about the adaptation of babies to their main food supply, milk. While some discussion may center around the transmission of the gene which controls the ability to digest milk, the main idea is the adaptive benefits of this ability.

KEY TO QUESTIONS FOR DISCUSSION

1. milk
2. The baby would starve unless a digestible substitute for mother's milk could be found.

GOING FURTHER

Students are encouraged to explore further the consequences of the inability to digest milk. Local dairy associations or community and state health personnel might be of assistance. These associations could provide statistics about the number of people affected by an inability to digest milk and some of the ways people adjust to this condition. A comparison can be made of the diets of different populations of people and the amount of milk products used. This information could be related to the number of people in that population who can digest milk.

The PKU problem can point up another genetic dietary condition that is more severe, but can be caught and managed. Nonetheless, PKU can still repeat itself in the next generation.

SELF QUIZ KEY

1. Babies can digest milk. This is their primary source of food. It is important to their survival that they be adapted to digest this important food.
2. Adults can eat other types of food. They do not depend primarily on milk for their nutrition. Therefore, it is not so important for adults to be able to digest milk.

NEW WORDS

lactose

enzyme

digest

ACTIVITY 25

CANCER AND HEREDITY

FOCUS

Students are introduced to some basic concepts concerning the mechanism, danger, and possible causes of cancer in humans.

OBJECTIVES

Students will have opportunities to

1. construct a model showing cell division.
2. relate the process of cell division to the mechanisms of cancer.
3. read about the incidence, dangers, and possible causes of cancer.
4. review cancer-related terms.

ADDITIONAL OPPORTUNITIES

Students will also have opportunities to

1. contact cancer societies for additional information.
2. investigate current topics in cancer research.

MATERIALS AND ADVANCE PREPARATION

Advance preparation is not necessary for this activity. Teacher materials needed are

2 slides: regular cell division, cancer
slide projector

The following items will be needed by each student or group of students performing this activity.

index card (3" x 5")
scissors
stapler

TEACHING CONSIDERATIONS

1. Cancer seems to permeate the health consciousness of American society. The emphasis of this activity is not to scare students. It is, instead, to provide them with some understanding of what having cancer is all about. When you show the slides stress that cancer is not a single disease, but like "rash," is a term that describes a wide variety of conditions and possible causes.

2. Although few "definites" have been determined by cancer research, many current theories ascribe cancer to genetic disorders or gene/environment interactions. Stress that there are probably many causes of cancer.

3. Some students may volunteer stories of cancer incidences within their own families. Consider such offerings with sensitivity; be aware that similar happenings may have caused trauma for other students in the class.

4. Sequence for cell division Flipbooklet: C-H-R-O-M-O-S-O-M-E-S-S-P-L-I-T.

5. Answers to crossword: ACROSS 1 - cancer, 3 - stomach, 6 - lung, 7 - tumor, 10 - surroundings, 11 - intestine, 12 - knows, 14 - benign, 17 - the, 18 - breast, 19 - changes; DOWN 1 - cell, 2 - cigarette, 4 - malignant, 5 - health, 7 - too, 8 - men, 9 - raise, 10 - skin, 13 - wart, 14 - be, 15 - gene, 16 - sore.

GUIDE TO CLASS DISCUSSION

The questions in student material are suggested for stimulating class discussion.

KEY TO QUESTIONS FOR DISCUSSION

1. The chromosomes pair and split when the cell divides. (Allow enough time for further descriptions that students may give.)
2. Cancer is characterized by uncontrolled cell division.
3. Environmental hazards, genetic predisposition
4. The cancerous cells can more easily be isolated and destroyed.
5. Early warning signs of possible cancer include:
 - a lump or thickening in the breast or elsewhere
 - unusual bleeding or discharge
 - a sore that does not heal
 - a change in a wart or mole
 - change in bowel or bladder habits
 - hoarseness or cough
 - indigestion or difficulty in swallowing

What should you do if one appears?

See a physician. Medical tests can determine if the signs are cancer related.

6. Answers will vary. Allow plenty of time for discussion.

GOING FURTHER

Students are encouraged to research the topic "cancer" by using the Reader's Guide to Periodical Literature to find related topics and by contacting the local American Cancer Society office.

SELF CHECK KEY

1. The crossword should be checked after class discussion. This can provide objective information as to the amount of content students understand in this activity.

NEW WORDS

cancer	leukemia
carcinogen	mutation
benign	malignant
tumor	

TEST ITEM BANK

YOU AND ME

1. Tom and Joe are identical twins. Joe weighs a lot more than Tom. Which factor is probably most responsible for this difference between them?
- a. diet
 - b. genes
 - c. chromosomes
 - d. all of the above

ANSWER: a

2. Question 1 is an example of the contribution that the _____ make(s) to individuality. Select the best word to complete the sentence.
- a. genes
 - b. climate
 - c. chromosomes
 - d. environment

ANSWER: d

3. The hereditary information that makes each of us unique is called _____.
- a. genes
 - b. sex
 - c. intelligence
 - d. environment

ANSWER: a

4. A characteristic that is determined only by genes is _____.
- a. blood type
 - b. height
 - c. weight
 - d. intelligence (IQ)

ANSWER: a

5. People are different only because they have different combinations of genes.
- a. true
 - b. false

ANSWER: b

6. Which of the following characteristics can you change?
- a. sex
 - b. eye color
 - c. blood type
 - d. weight

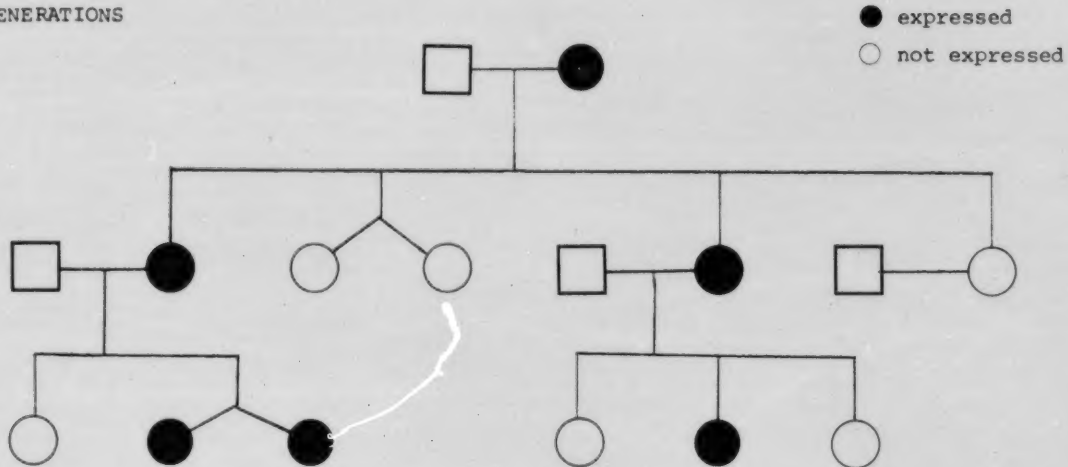
ANSWER: d

7. Which of the following skills could not be improved by practicing?

- a. swimming 50 meters
- b. running 400 meters
- c. hearing high frequency sounds
- d. reading music

ANSWER: c

GENERATIONS



Answer the following questions using the above diagram.

1. The diagram above is called _____.

- a. a pedigree
- b. a chromosome pattern
- c. circles and squares
- d. a chromosome map

ANSWER: a

2. How many children were born as generation 2?

ANSWER: 5

3. How many of the children in generation 2 are boys?

ANSWER: 0

4. In how many generations is a certain characteristic expressed?

ANSWER: 3

5. In generation 2, how many of the children have married?

ANSWER: 3

Answer the following questions.

6. Bob and Joan have five children. Two children are female and three are male. The chance that the next child will be a female is _____.

- a. one in ten
- b. one in five
- c. one in six
- d. one in two

ANSWER: d

7. Parents who have many children have _____.

- a. a greater chance of having boys.
- b. a greater chance of having girls
- c. equal numbers of boys and girls
- d. an equal chance to have a boy or girl with each pregnancy

ANSWER: d

8. A father contributes to his child _____.

- a. mostly dominant genes
- b. mostly recessive genes
- c. equal numbers of dominant and recessive genes
- d. one of each gene pair

ANSWER: d

9. A mother contributes to her child _____.

- a. mostly dominant genes
- b. mostly recessive genes
- c. 23 genes
- d. none of the above

ANSWER: d

10. A genetic condition cannot be caught from another person because _____.

- a. genetic conditions happen when you are old
- b. genetic conditions are inherited
- c. genetic conditions are modified by the environment
- d. all of the above

ANSWER: b

11. A cell with 23 chromosomes is _____.

- a. a liver cell
- b. a muscle cell
- c. a sperm cell
- d. a blood cell

ANSWER: c

12. A male's sex chromosomes are _____ and _____.

ANSWER: X and Y

13. A female's sex chromosomes are _____ and _____/

ANSWER: X and X

14. Only sex cells (egg and sperm cells) have sex chromosomes.

- a. true
- b. false

ANSWER: b

15. Because brothers have the same parents, all of their genes are the same.

- a. true
- b. false

ANSWER: b

16. All of a parent's characteristics are transmitted to her or his children.

- a. true
- b. false

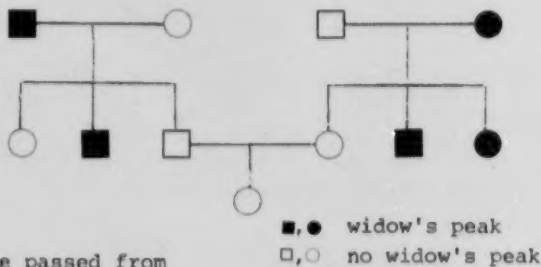
ANSWER: b

17. Mr. and Ms. Miles have four girls. Ms. Miles is pregnant. What is the probability that the Miles will have a baby boy?

ANSWER: 1/2 or 50%

18. Suppose that widow's peak is inherited as a dominant characteristic. What is the probability that Marcia (pedigree to the right) has a widow's peak?

ANSWER: 0%



19. Which characteristic could not be passed from a mother to her children through the genes?

- a. blood type
- b. skin color
- c. eye color
- d. knowledge of a foreign language

ANSWER: d

20. The genes are passed from parent to child on the _____.

- a. family tree
- b. chromosomes
- c. karyotype
- d. blood cells

ANSWER: b

21. Half of our genetic information comes to us from each of our parents.

- a. true
- b. false

ANSWER: a

22. Similarities between parents and children can be _____.

- a. predicted with great certainty
- b. due only to genetic factors
- c. expected because of shared genes
- d. dismissed as accidents

ANSWER: c

VARIETY

1. In Bill's 8th grade class, the average height for the boys was 5'5". Bill was 5'2" and was the shortest boy in the class.

Is Bill average? Explain your answer.

Is Bill normal? Explain your answer.

ANSWER: Bill is not average since he is the shortest boy. He is normal because variation is normal in the human population. Normal and average are not the same thing.

2. In 8th grade, Bill was the shortest boy in his class at 5'2". As a senior in high school, Bill is now 6'0" and is one of the tallest boys in school. Explain how Bill's genetic makeup could have influenced his growth pattern.

ANSWER: Genes act at different times in different people. Bill's genes could have "turned on" and made him grow rapidly and become one of the tallest boys in school by the time he was a senior. It is normal for people to delay starting rapid growth spurts and then bypass their classmates in height. Bill's genes could have been a major reason for his short height in the 8th grade and his tall height in his senior year.

3. All primates have the same chromosomes.

- a. true
- b. false

ANSWER: b

4. Examples of genetic information that contributes to variety in living things include _____.

- a. different genes
- b. different environments
- c. different locations of cells
- d. all of the above

ANSWER: a

5. List two examples of variation in different kinds of living organisms.

ANSWER: Variation is a means of sorting different kinds of living organisms. For example, reptiles have dry, scaly skins; birds have feathers and warm blood; mammals have hair and secrete milk for their young. Variation is usually easily visible between organisms of different kinds.

6. List two examples of variation in the same kind of living organisms.

ANSWER: Variation between organisms of the same kind of living things is usually not so visible as between different kinds of organisms. For example everyone can easily describe the differences between horses and elephants. However, it is not as easy to describe the differences between individual elephants or between individual horses. If one observes closely living organisms that are of the same kind, variations such as size, color, and shape can be seen. Variation between living things is normal and present in all kinds of living organisms.

7. Describe the variation that can be found among the students in your classroom in shoe size, height, weight, and sex.

8. Students in a typical 8th grade class would be most likely to _____.

- a. vary more in height than students in a 12th grade class
- b. vary less in height than students in a 12th grade class
- c. vary about the same amount in height as students in a 12th grade class

ANSWER: a

9. Most people go through similar stages of growth.

- a. true
- b. false

ANSWER: a

10. Most people go through growth stages at the same speed.

- a. true
- b. false

ANSWER: b

11. No two people are exactly alike.

- a. true
- b. false

ANSWER: a

12. Characteristics that do not change as one grows older include _____.

- a. sex
- b. blood type
- c. weight
- d. a and b
- e. a, b, and c

ANSWER: d

13. Birth defects ruin a person's life.

- a. true
- b. false

ANSWER: b

14. When solving a problem, a "best" decision may vary with different individuals.

- a. true
- b. false

ANSWER: a

CHANGE

1. Place the following stages of growth in the correct sequence: adolescence, growth before birth, adulthood, childhood.

ANSWER: growth before birth, childhood, adolescence, adulthood

2. Girls and boys grow at the same speed during adolescence.

- a. true
- b. false

ANSWER: b

3. Because all people have the same tissues, organs and systems, all people are equally likely to get the same kinds of illnesses.

- a. true
- b. false

ANSWER: b

4. Sexual maturity occurs during the stage of human growth called _____.

- a. growth before birth
- b. adolescence
- c. adulthood
- d. old age

ANSWER: b

5. Once a person reaches adulthood, he or she no longer changes.

- a. true
- b. false

ANSWER: b

6. Humans grow the most in height during the growth stage called adulthood.

- a. true
- b. false

ANSWER: b

7. Adolescence occurs at the same age in all people.

- a. true
- b. false

ANSWER: b

8. A timeline is used to show _____.

- a. a family tree
- b. events over a period of time
- c. distance traveled in a segment of time
- d. stages such as marriage and divorce

ANSWER: b

9. Which of the following is not a biological phase of human life?

- a. adolescence
- b. prenatal life
- c. old age
- d. marriage
- e. childhood

ANSWER: d

10. The age when sexual maturity and an increase in growth occurs is under the control of _____ as well as environmental factors.

- a. personal
- b. genetic
- c. social
- d. cultural

ANSWER: b

11. Signs of growing up in adolescents include _____.

- a. increased growth
- b. sexual development
- c. changing attitudes
- d. all of the above

ANSWER: d

12. Which of the following does not change as a person grows?

- a. size
- b. sex
- c. attitudes
- d. weight

ANSWER: b

13. The genes in your body are "turned on" to function all at the same time.

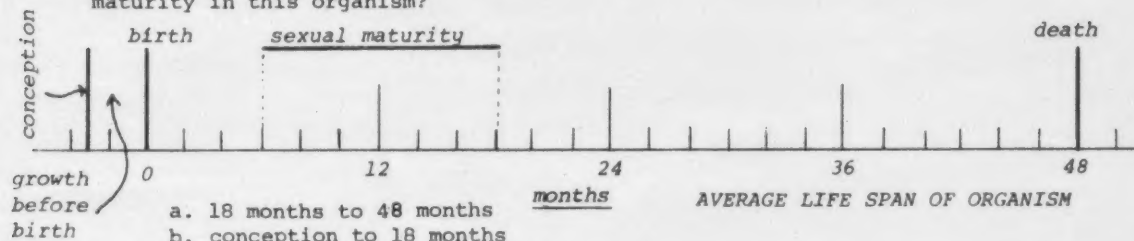
- a. true
- b. false

ANSWER: b

14. Draw a timeline showing the stages of human growth and development.

ANSWER: see student materials

15. Look at the timeline below. What is the range for the onset of sexual maturity in this organism?



- a. 18 months to 48 months
- b. conception to 18 months
- c. 6 to 18 months
- d. birth to 6 months

ANSWER: c

ENVIRONMENT

1. List two examples of how humans change their environment.

ANSWER: Answers may range from personal to industrial examples.

2. Twins of the same sex are always identical twins.

- a. true
- b. false

ANSWER: b

3. Identical twins are always of the same sex.

- a. true
- b. false

ANSWER: a

4. List two ways that human adaptation is different from the way plants and other animals adapt.

ANSWER: Answers should include examples of social and cultural changes.

5. Genetic information that can cause health problems causes equally great problems in all environments.

- a. true
- b. false

ANSWER: b

6. Even though you cannot change your genes, sometimes you can change their effect by altering the environment.

- a. true
- b. false

ANSWERS: a

7. Genes help to determine all our characteristics. Therefore, a person who is below average in height will be below average in other characteristics.

- a. true
- b. false

ANSWER: b

8. Which two people would probably share more of the same genes?

- a. brother and sister
- b. cousins
- c. grandmother and granddaughter
- d. uncle and nephew

ANSWER: a

9. Which of the following would be a good decision for a person with a genetic tendency toward heart disease?

- a. eat foods with a high fat content
- b. work in a stressful environment
- c. avoid exercise
- d. stop smoking

ANSWER: d

10. A person's health is partly determined by her or his genes. Therefore _____.

- a. a person's health status cannot be changed
- b. people in the same family will always get the same illnesses
- c. illness is caused by a person's genes
- d. people can often control their health by changing the environment that interacts with their genes

ANSWER: d

11. Which of the following are least likely to be similar in identical twins?

- a. sex
- b. blood type
- c. weight
- d. eye color

ANSWER: c

12. Genetic variation in people causes them to react differently to different types of environments.

- a. true
- b. false

ANSWER: a

13. Cancer results from _____ cell division.

- a. controlled
- b. uncontrolled
- c. absent
- d. normal

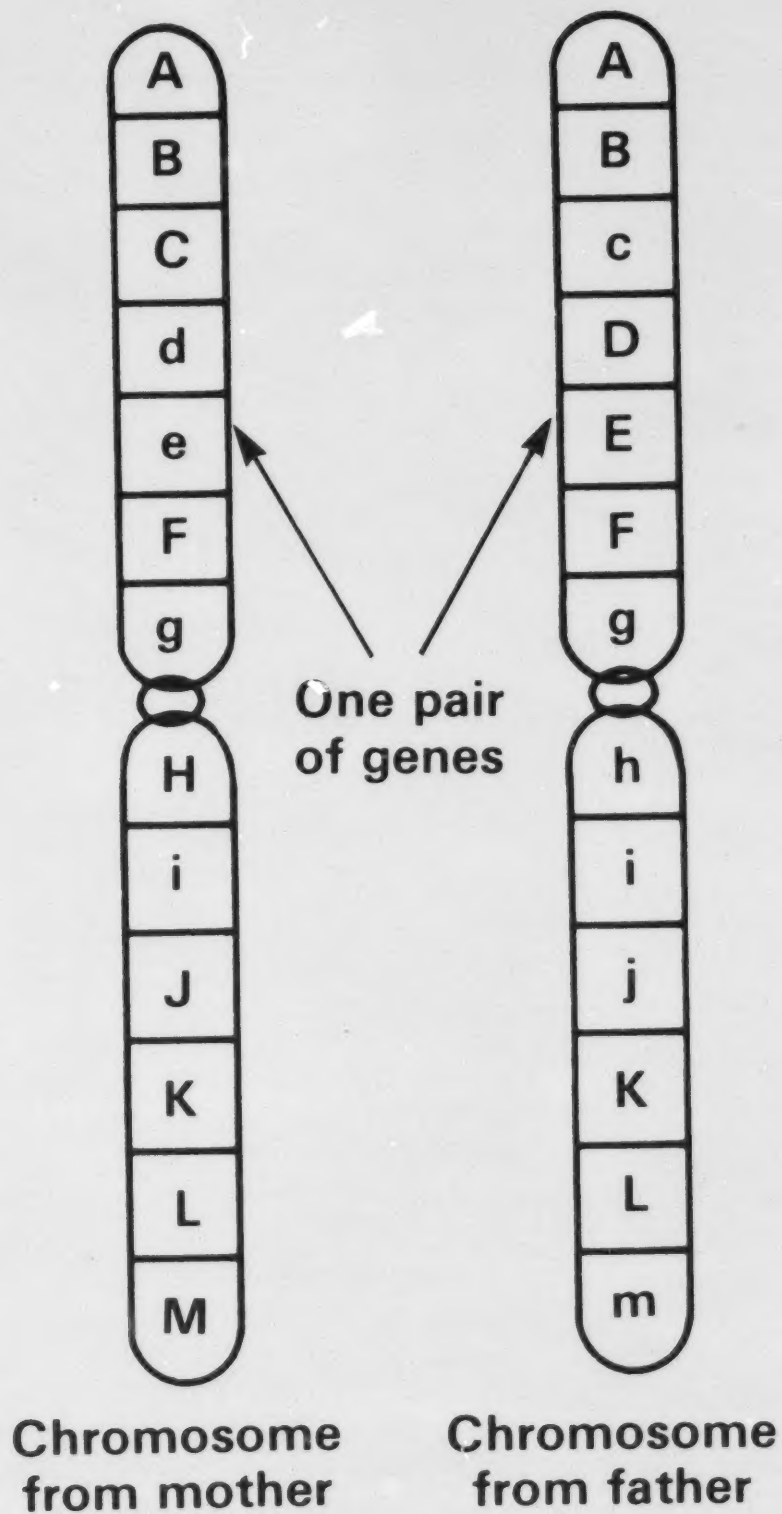
ANSWER: b

14. Alice and Jennifer are identical twins. They were separated at birth and reunited at age 17. Alice loves classical music and plays cello in her school's string quartet. She does not like sports very much and considers herself unathletic. Jennifer holds the city record for the women's 400 meter run. She enjoys listening to music, but does not play an instrument; Jennifer says she has no talent in that area. In an essay, describe how these differences could have come about in identical twins. List at least three factors that might have made Alice and Jennifer different.

ANSWER: Alice and Jennifer have the same genetic inheritance. Differences are due primarily to environmental influences on their environment.

TEARSHEETS

5



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ACTIVITY 3 MYSTERY CLUES

MYSTERY CLUE NO. 1

NO ONE IS IN THE SAME CLASS
SECOND PERIOD.

MYSTERY CLUE NO. 2

ANN HAS LUNCH FIFTH PERIOD
AND DOESN'T HAVE MUSIC AT
ALL.

MYSTERY CLUE NO. 3

MARK HAS MATH FIRST PERIOD.

MYSTERY CLUE NO. 4

DAN HAS PHYSICAL EDUCATION
FIRST PERIOD.

MYSTERY CLUE NO. 5

RITA IS IN THE SAME CLASS AS
MARK FIRST PERIOD.

MYSTERY CLUE NO. 6

SUE HAS SCIENCE SIXTH PERIOD.

MYSTERY CLUE NO. 7

JEFF HAS ART SIXTH PERIOD.

MYSTERY CLUE NO. 8

JEFF HAS THE SAME CLASSES AS
ANN FIFTH AND SIXTH PERIODS.

MYSTERY CLUE NO. 9

DAN HAS THE SAME CLASS AS
ANN FIRST PERIOD.

MYSTERY CLUE NO. 10

SUE HAS ENGLISH AND JEFF HAS
MUSIC SECOND PERIOD.

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ACTIVITY 3 MYSTERY CLUES

MYSTERY CLUE NO. 11

MARK AND ANN HAVE THE SAME
CLASS FOURTH AND FIFTH PERIODS.

MYSTERY CLUE NO. 12

ANN HAS SCIENCE SEVENTH
PERIOD.

MYSTERY CLUE NO. 13

ANN DOES NOT HAVE MATH
THIRD PERIOD.

MYSTERY CLUE NO. 14

RITA HAS LUNCH FIFTH
PERIOD.

MYSTERY CLUE NO. 15

RITA AND MARK HAVE THE SAME
FOURTH-PERIOD CLASS.

MYSTERY CLUE NO. 16

DAN HAS HISTORY SECOND
PERIOD.

MYSTERY CLUE NO. 17

RITA DOESN'T HAVE PHYSICAL
EDUCATION SECOND PERIOD.

MYSTERY CLUE NO. 18

NO ONE HAS ART SECOND PERIOD.

MYSTERY CLUE NO. 19

MARK DOESN'T HAVE ENGLISH
FOURTH PERIOD.

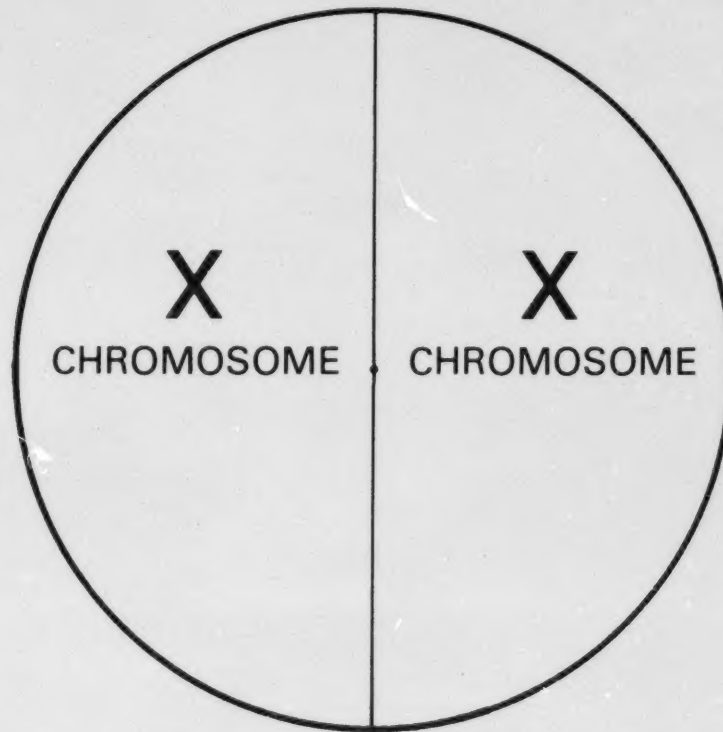
MYSTERY CLUE NO. 20

RITA DOESN'T HAVE MUSIC
FOURTH PERIOD.

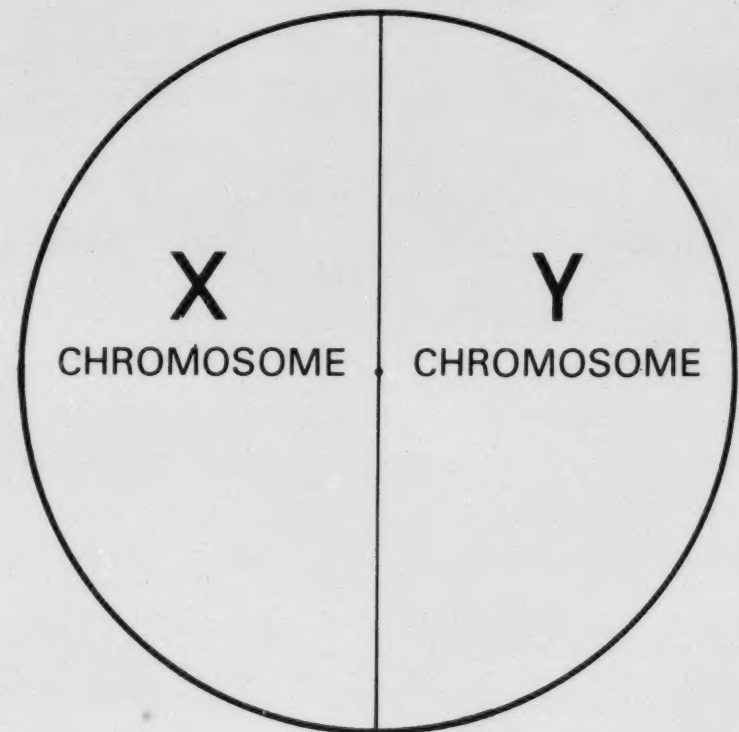
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INHERITANCE SPINNER

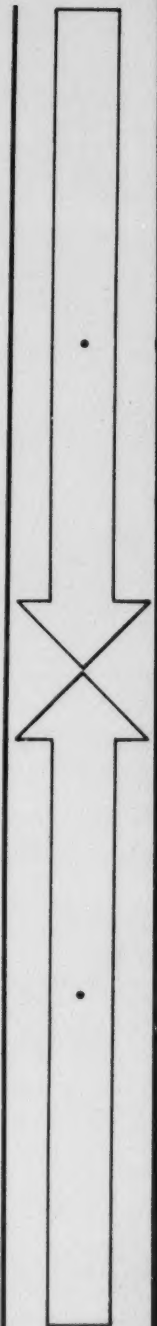
CUT OUT THE POINTERS. USE A PUSH PIN TO CENTER THE POINTERS ON THE SPINNERS. PUSH THE PIN THROUGH THE DOTS IN THE POINTERS AND SPINNERS. USE SOMETHING LIKE A THICK PIECE OF CARDBOARD AS A BACKING.



MOTHER



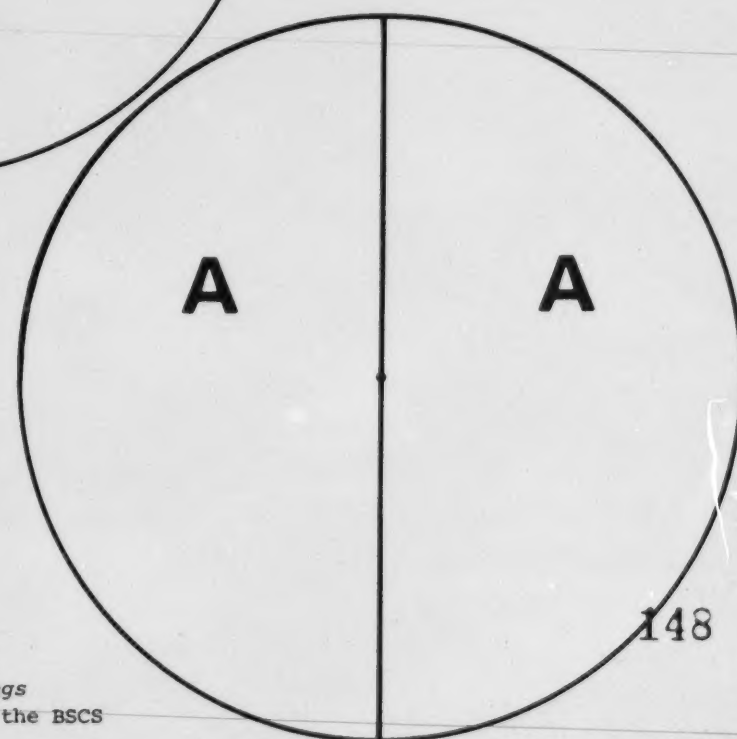
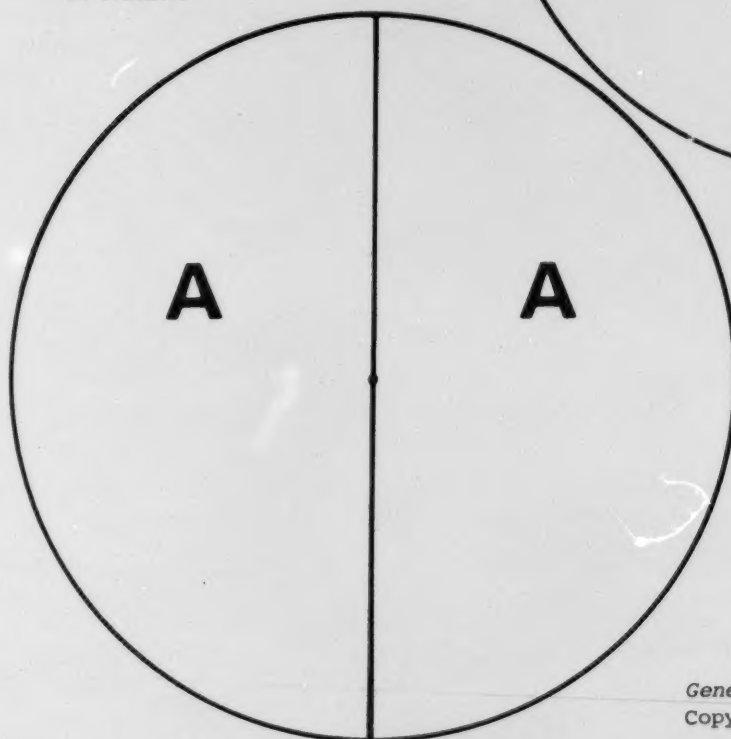
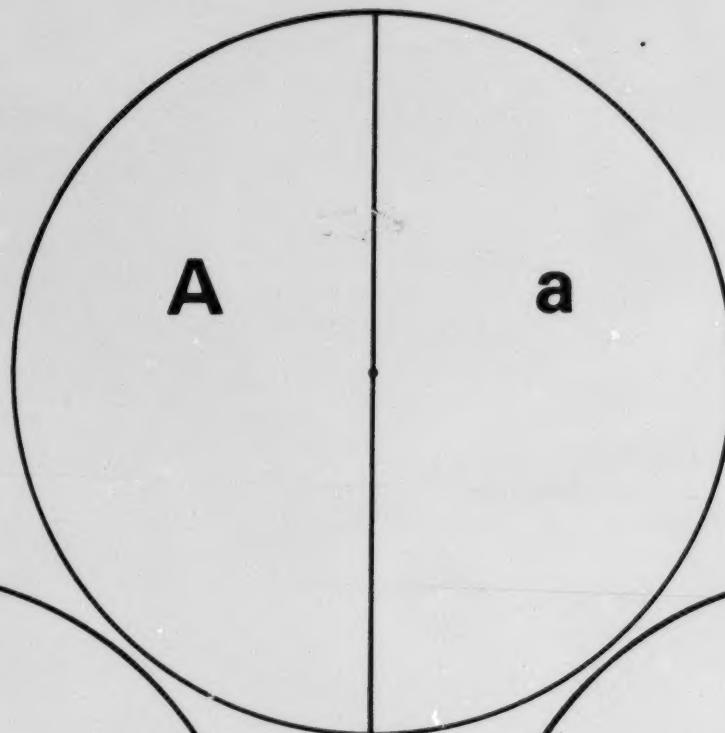
FATHER



SPINNER CARDS

SET 1

CUT OUT THE SPINNER CARDS. THESE CARDS WILL FIT OVER THE SPINNERS ON THE INHERITANCE SPINNER. TO USE THEM, REMOVE THE POINTERS FROM THE INHERITANCE SPINNER. PUSH THE PIN THROUGH THE POINTER, THEN THROUGH THE NEW SPINNER CARD, THEN THROUGH THE INHERITANCE SPINNER.



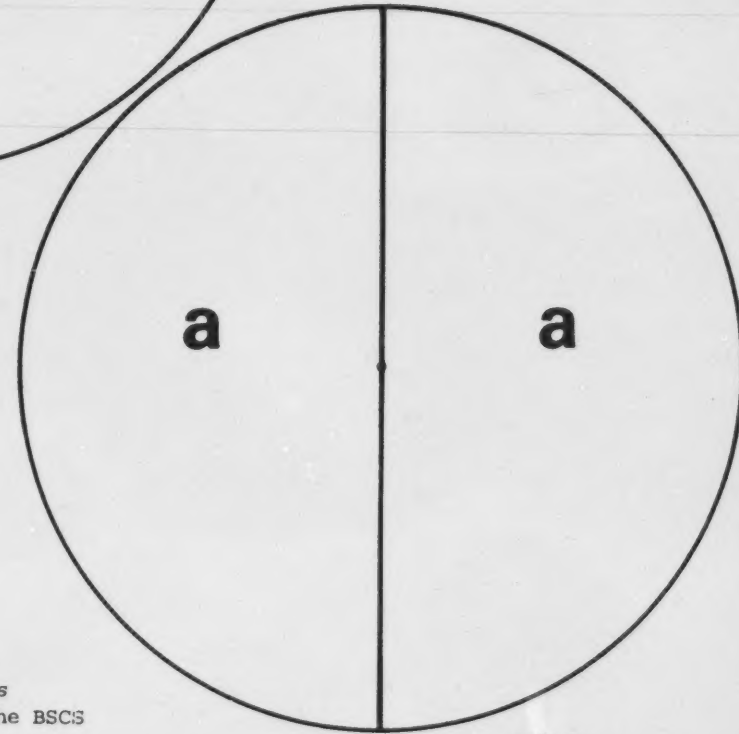
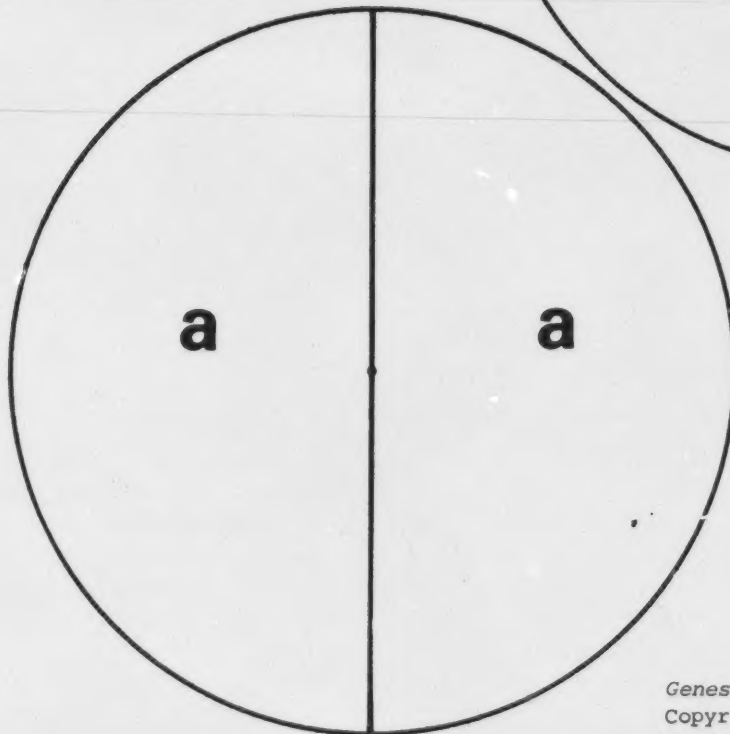
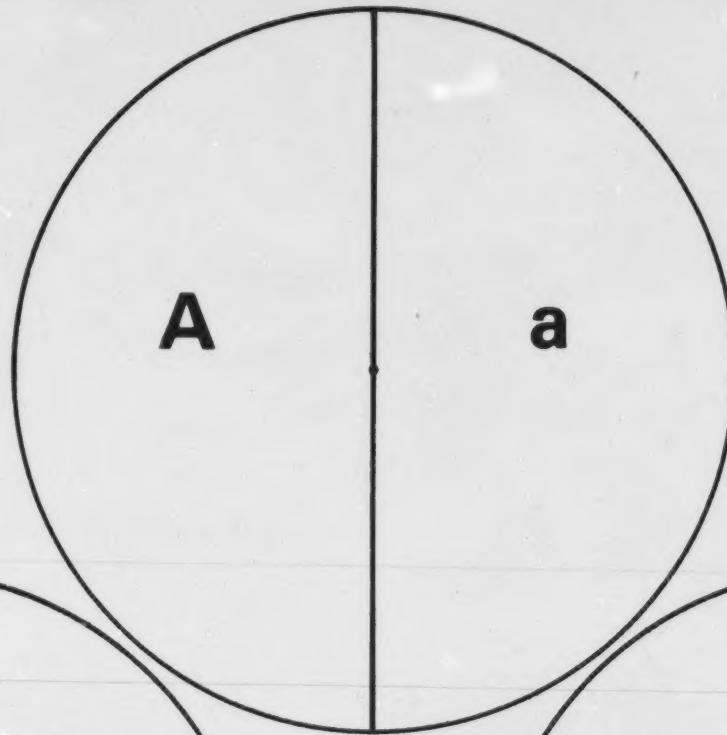
147

148

SPINNER CARDS

SET 2

CUT OUT THE SPINNER CARDS. THESE CARDS WILL FIT OVER THE SPINNERS ON THE INHERITANCE SPINNER. TO USE THEM, REMOVE THE POINTERS FROM THE INHERITANCE SPINNER. PUSH THE PIN THROUGH THE POINTER, THEN THROUGH THE NEW SPINNER CARD, THEN THROUGH THE INHERITANCE SPINNER.



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SET A, CARD 1



PP plain head



pp head with horns



SS short ears



ss long ears



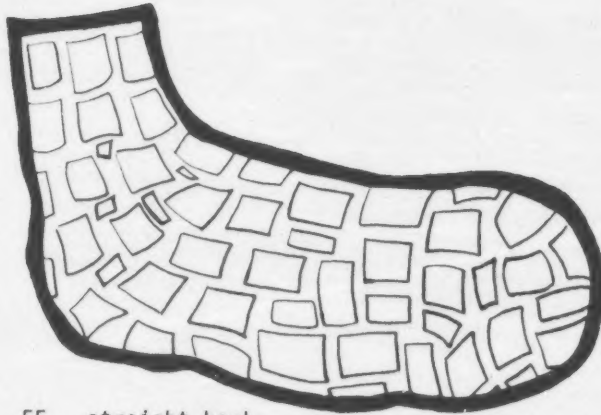
NN no eyebrows



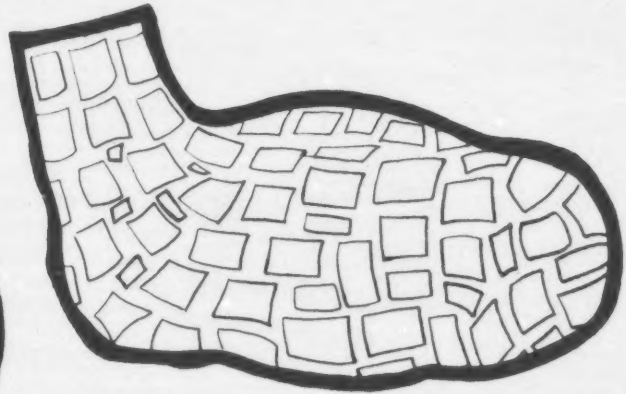
nn eyebrows

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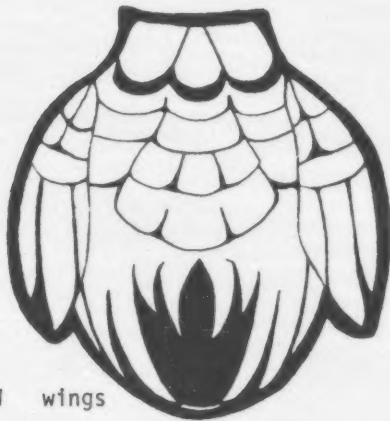
SET A, CARD 2



EE straight back



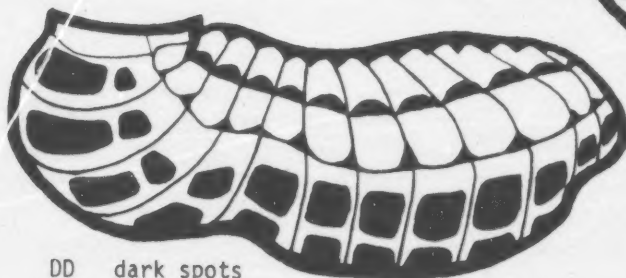
ee humped back



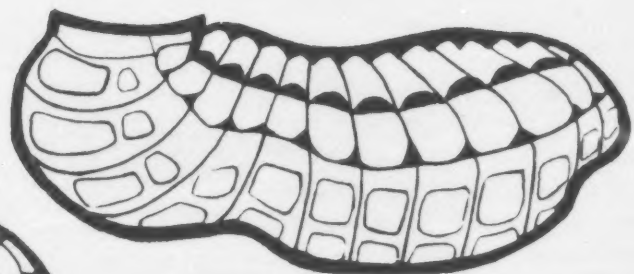
WW wings



ww no wings



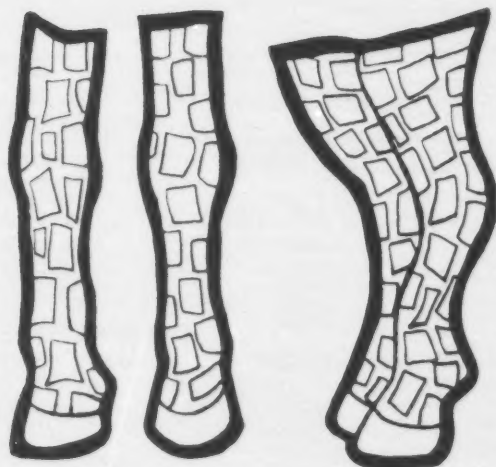
DD dark spots



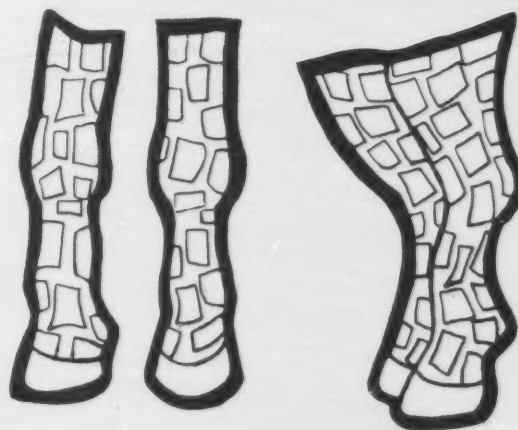
dd light spots

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SET A, CARD 3



AA long legs



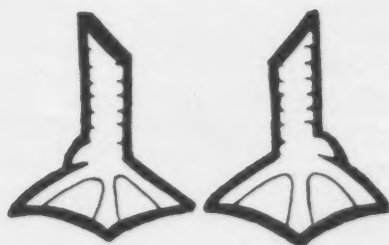
aa short legs



CC legs with spots



cc legs without spots



FF feet without claws



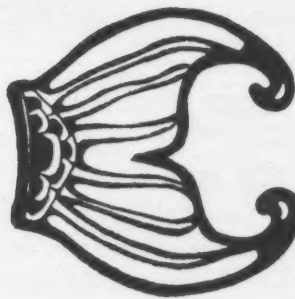
ff feet with claws

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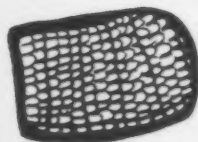
SET A, CARD 4



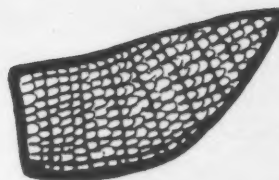
TT plain tail



tt fancy tail



BB blunt tail



bb pointed tail



LL long tail



ll short tail

SET B, CARD 1



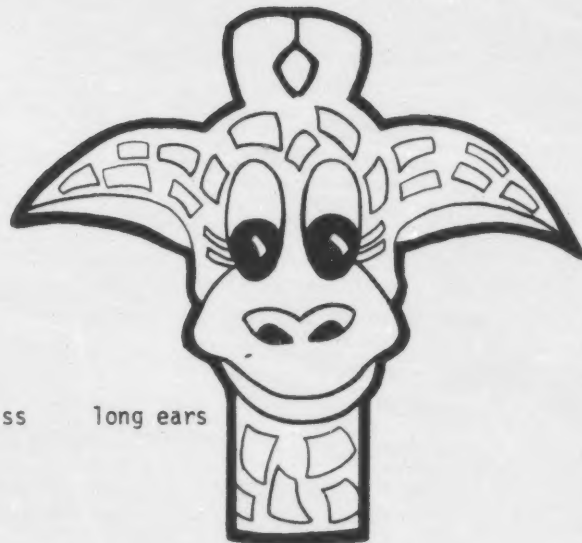
PP or Pp plain head



pp head with horns



SS or ss short ears



ss long ears



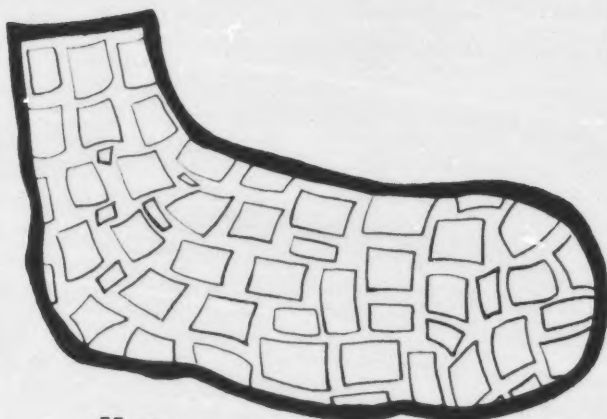
NN or Nn no eyebrows



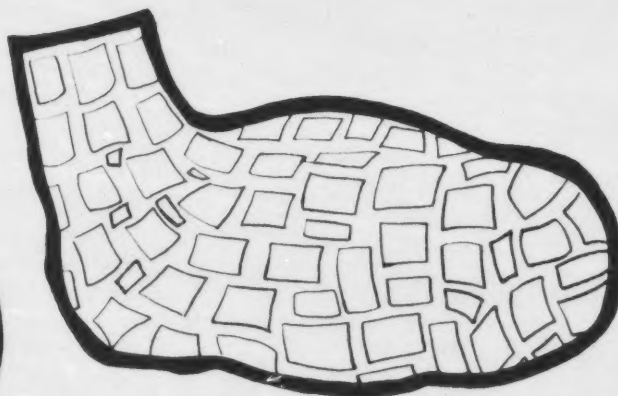
nn eyebrows

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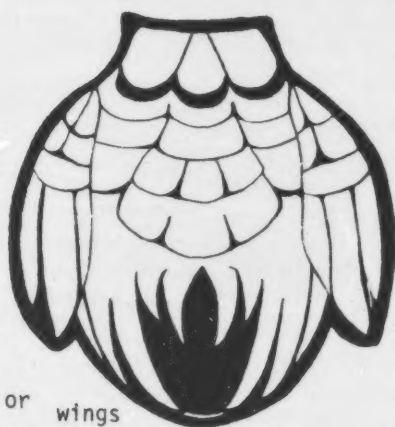
SET B, CARD 2



EE or Ee straight back



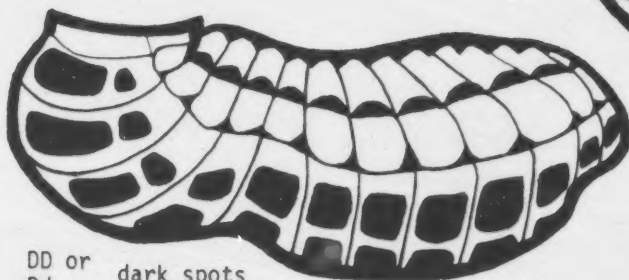
ee humped back



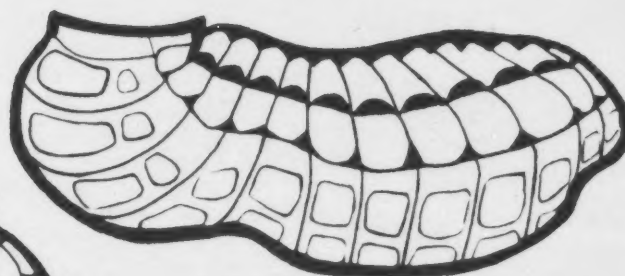
WW or Ww wings



ww no wings



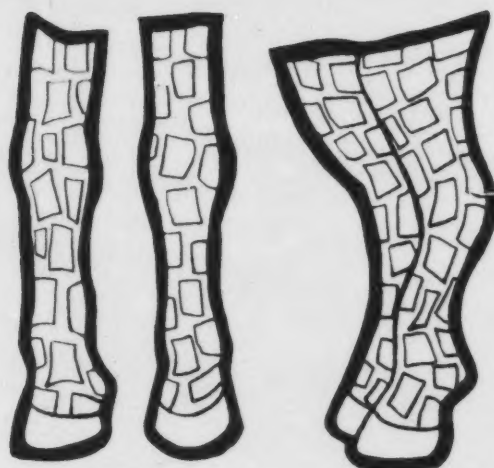
DD or Dd dark spots



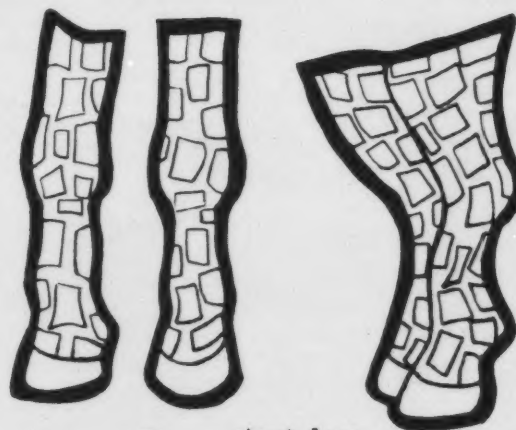
dd light spots

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SET B, CARD 3



AA or
Aa long legs



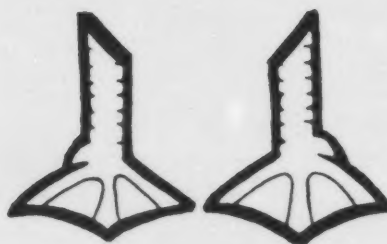
aa short legs



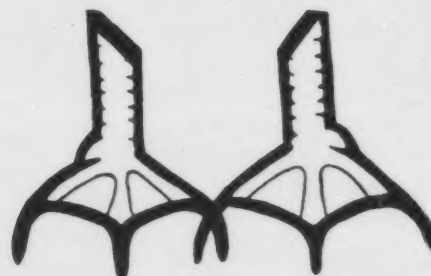
CC or
Cc legs with spots



cc legs without spots



FF or
Ff feet without claws



ff feet with claws

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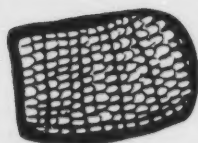
SET B, CARD 4



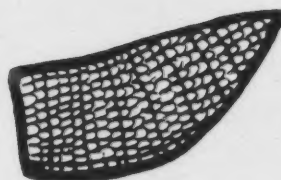
TT or
Tt plain tail



tt fancy tail



BB or
Bb blunt tail



bb pointed tail

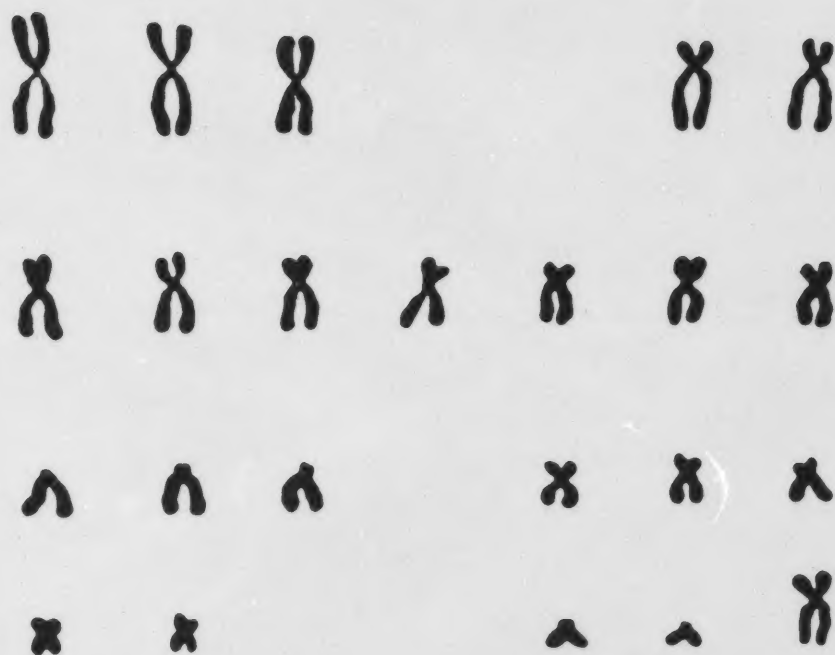


LL or
Ll long tail



ll short tail

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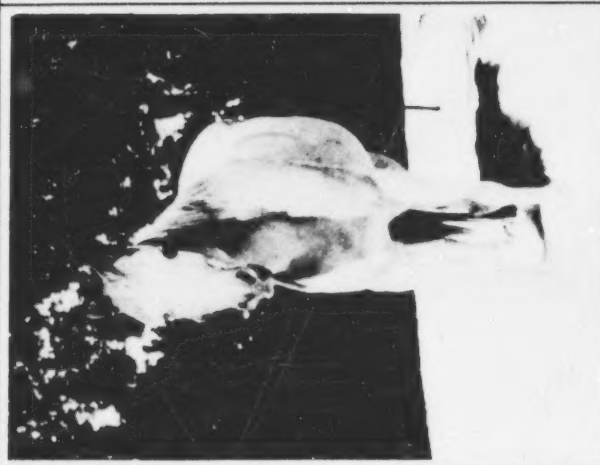
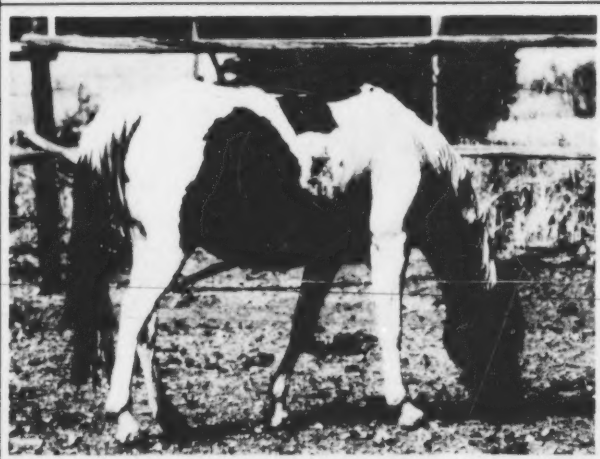
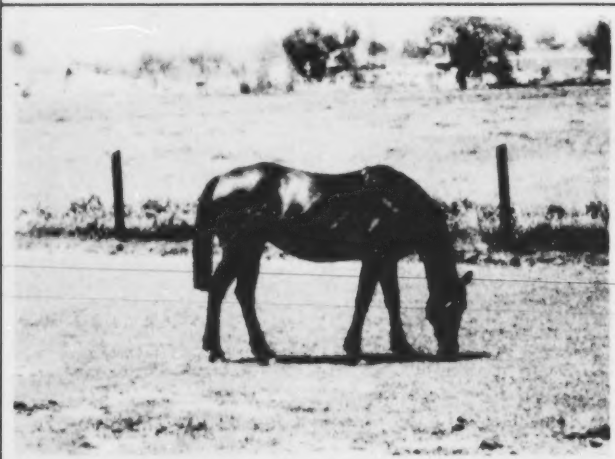
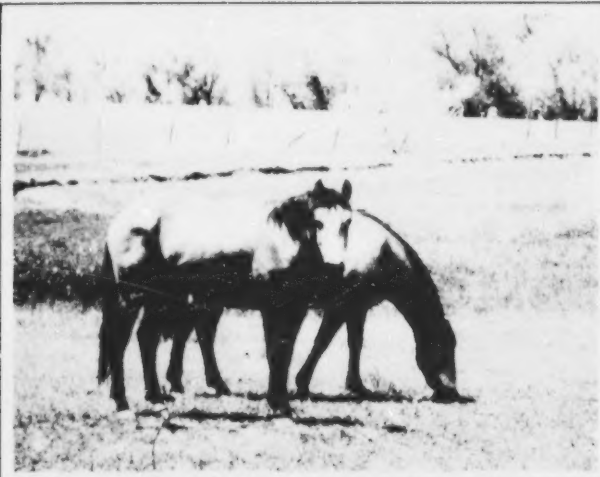
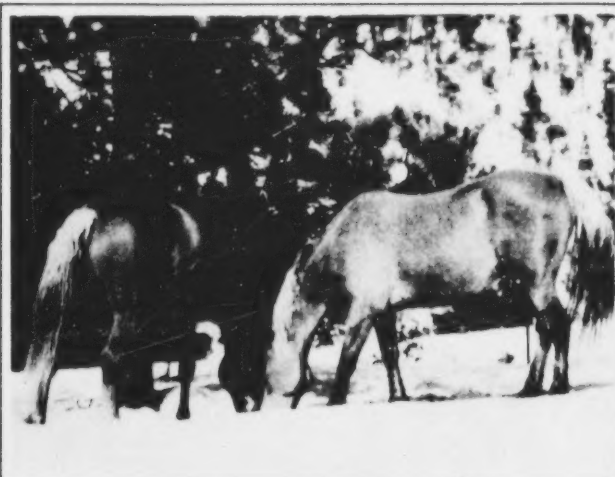
(A)



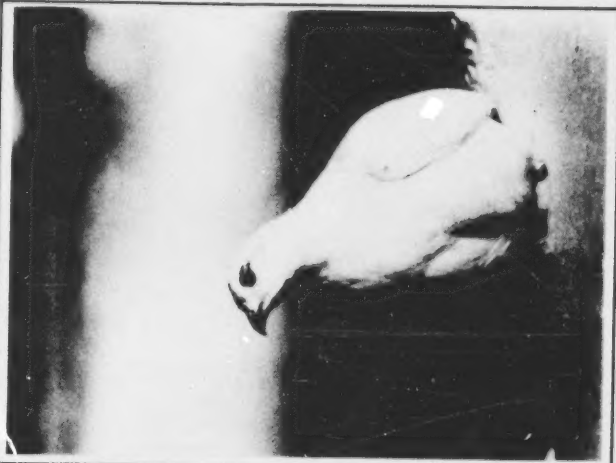
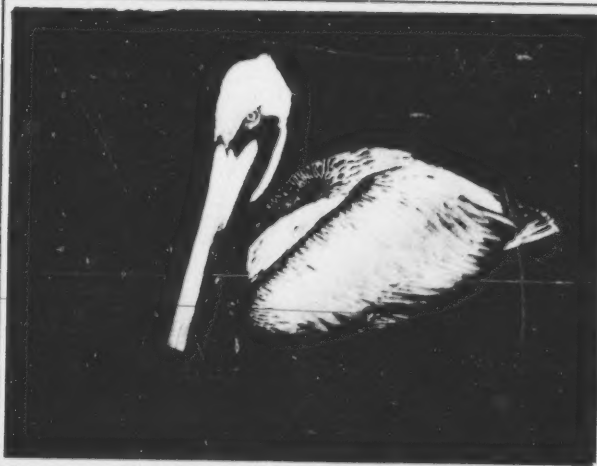
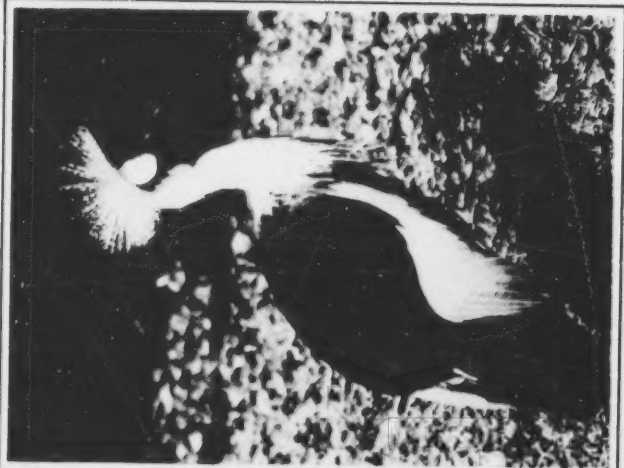
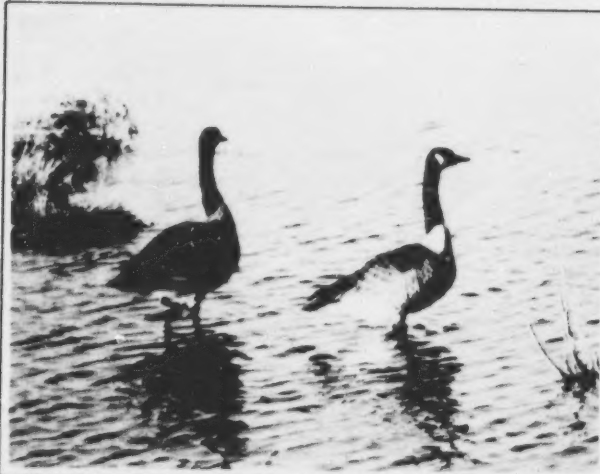
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(B)

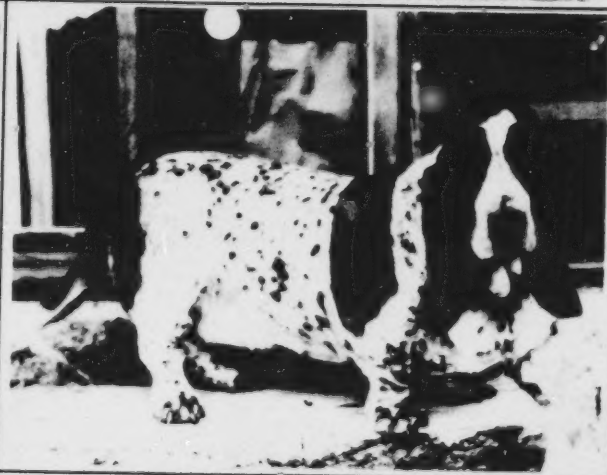




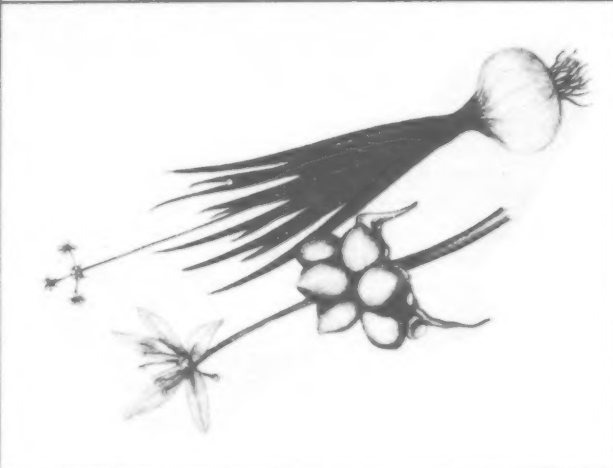
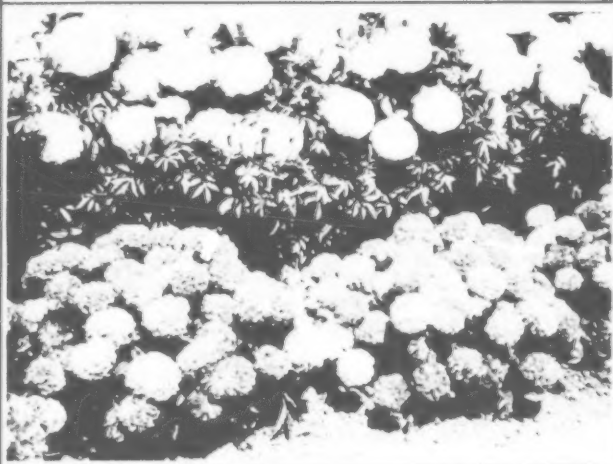
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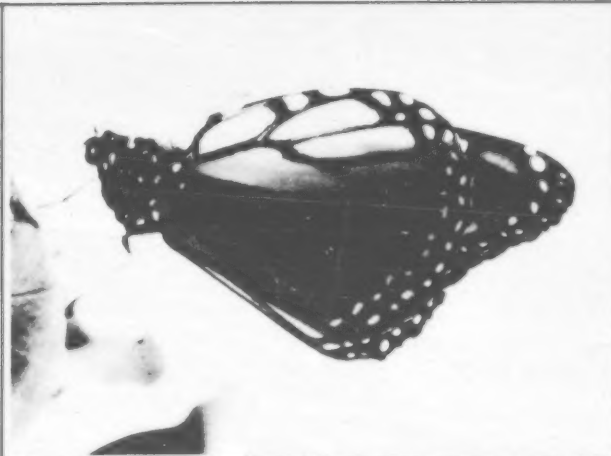
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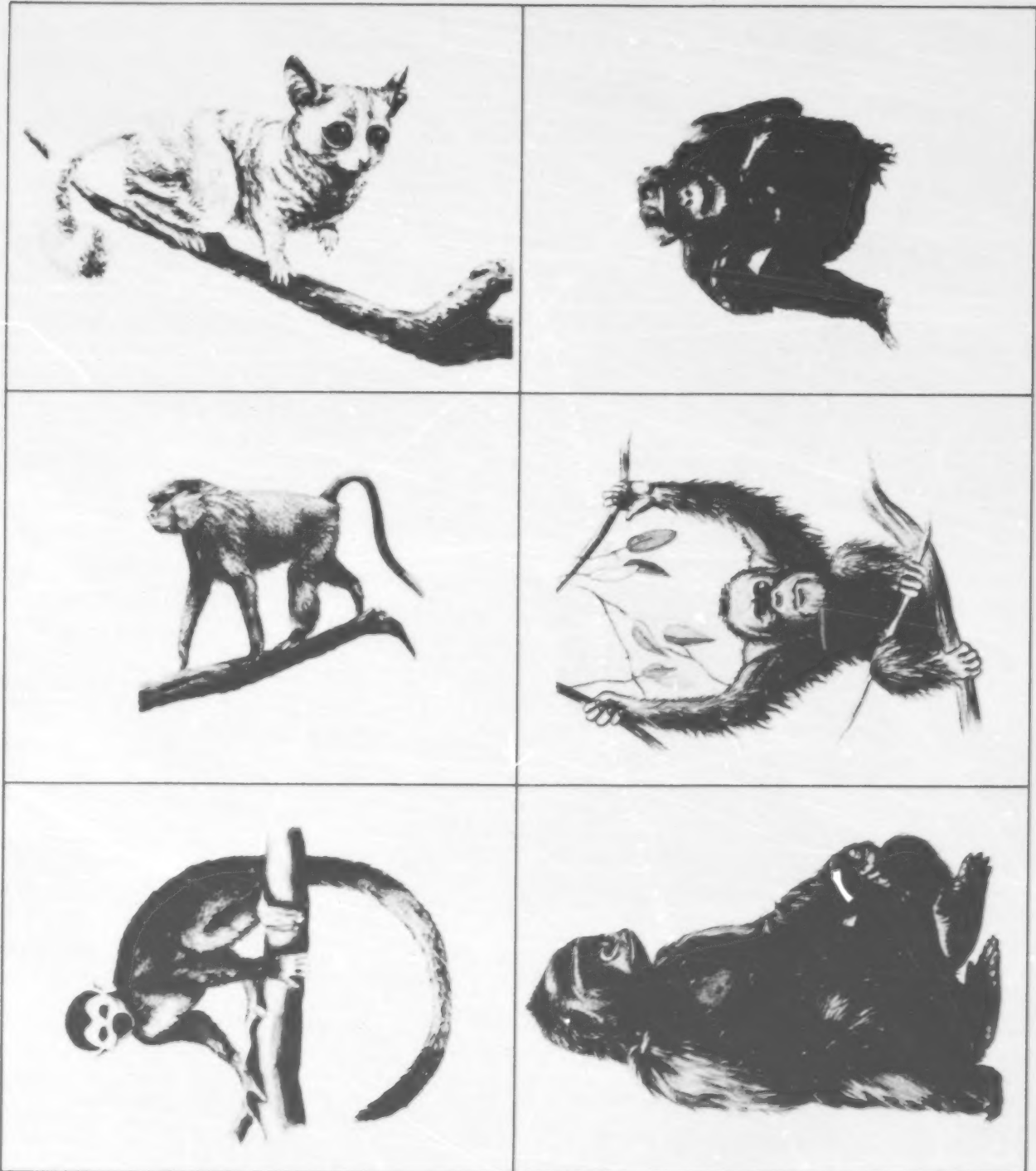
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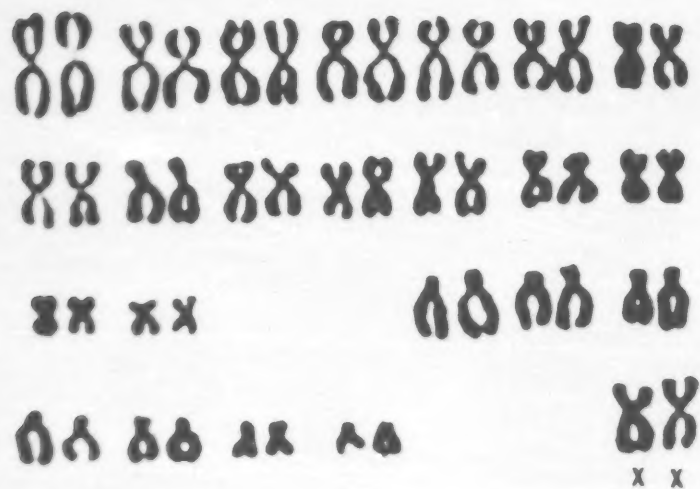
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GORILLA

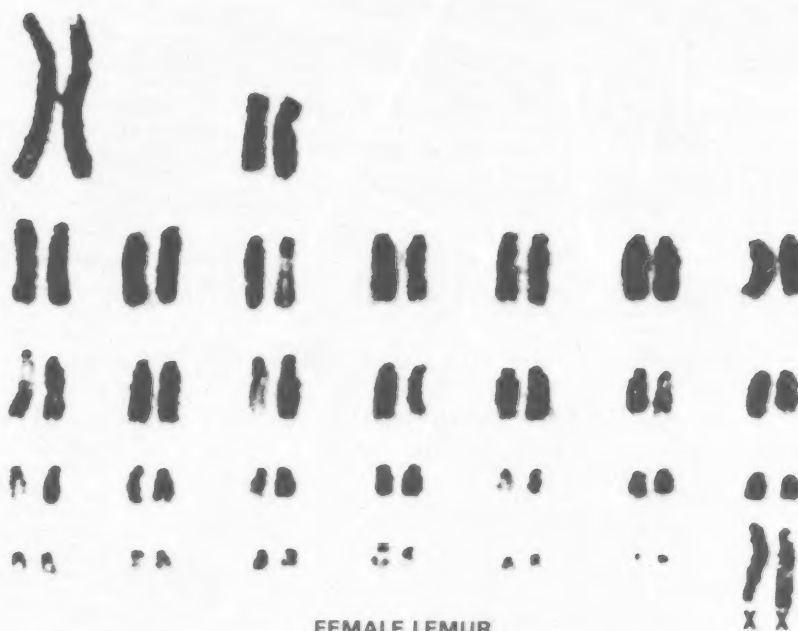


CHIMPANZEE

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MOUSE



FEMALE LEMUR

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TIME PERIOD: PREHISTORIC		ROLE
ROLES TO PLAY	JOBS TO BE DONE	
MOTHER	GETTING FOOD FOR EVENING MEAL	
FATHER	HEATING THE HOUSE	
DAUGHTER (15 years old)	COOKING THE FOOD	
SON (12 years old)	WASHING THE DISHES	
CHILD (2 years old)	CLEANING THE FLOORS AFTER MEALS	
	PLAYING WITH THE YOUNG CHILD	

TIME PERIOD: PIONEER DAYS		CARD
ROLES TO PLAY	JOBS TO BE DONE	
MOTHER	GETTING FOOD FOR EVENING MEAL	
FATHER	HEATING THE HOUSE	
DAUGHTER (15 years old)	COOKING THE FOOD	
SON (12 years old)	WASHING THE DISHES	
CHILD (2 years old)	CLEANING THE FLOORS AFTER MEALS	
	PLAYING WITH THE YOUNG CHILD	

TIME PERIOD: EARLY 1900s	
ROLES TO PLAY	JOBS TO BE DONE
MOTHER	GETTING FOOD FOR EVENING MEAL
FATHER	HEATING THE HOUSE
DAUGHTER (15 years old)	COOKING THE FOOD
SON (12 years old)	WASHING THE DISHES
CHILD (2 years old)	CLEANING THE FLOORS AFTER THE MEAL
	PLAYING WITH THE YOUNG CHILD

TIME PERIOD: MODERN TIMES	
ROLES TO PLAY	JOBS TO BE DONE
MOTHER	GETTING FOOD FOR EVENING MEAL
FATHER	HEATING THE HOUSE
DAUGHTER (15 years old)	COOKING THE FOOD
SON (12 years old)	WASHING THE DISHES
CHILD (2 years old)	CLEANING THE FLOORS AFTER THE MEAL
	PLAYING WITH THE YOUNG CHILD

GENES AND SURROUNDINGS



The Center for Education in
Human and Medical Genetics



TEACHER'S GUIDE



A Continuing Program of the BSCS



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